FINAL REPORT

MODIFICATION, FABRICATION, TESTING & DELIVERY

of

ITT Model F4012 RP Tube/Coil Assembly

for

N A S A

MARSHAL SPACE FLIGHT CENTER

Contract NAS8-29918

(NASA-CR-120612) MODIFICATION, FABRICATION, TESTING AND DELIVERY OF ITT MODEL F4012 RP TUBE/COIL ASSEMBLY Final Report (ITT Gilfillan, Inc.) 104 p HC $5.25 CSCL 09/5 N75-18483 Unclas G3/33 11723

by

ITT GILFILLAN

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1.0 INTRODUCTION

This report summarizes the results of the ITT model F4012 RP image dissector tube and coil improvement program. Included with a technical summary are the following:

Appendix A	-	Vidissector Image Dissector Tube Test Data for S/N 037403 (S/N 1 Assembly component)
Appendix B	-	Vidissector Image Dissector Tube Test Data for S/N 037404 (S/N 2 Assembly component)
Appendix C	-	F4012 RP Deflection Assembly Test Data Model 8008946-1, S/N 1 (S/N 1 Assembly component)
Appendix D	-	F4012 RP Deflection Assembly Test Data Model 8007846-1, S/N 2 (S/N 2 Assembly component)
Appendix E	-	Final Report "Improved F4012 Image Dissector Coil Assembly" by R. Hertel, ITT Aerospace - Optical Division, Ft. Wayne, Indiana
Appendix F	-	Test Plan (including results of tests on Tube/Coil Assembly S/N 1) of ITT Model F4012 RP Tube/Coil Assemblies by ITT Gilfillan
Appendix G	-	Component Schematics: voltage divider, deflection assembly, shield-magnetic, Process Spec. - Shell EPON 828

The objective of the Tube/Coil Improvement program was to improve the characteristics of an F4012 RP tube/coil assembly to make it more accurate for the Large Space Telescope trackers' applications. Section 2.0 of this report compares the performance of the new components to the original design goals. Section 3.0 presents recommendations of further tests and/or design changes to further improve the F4012 RP tube/coil assembly performance.

2.0 PERFORMANCE

The general work statement of this program called for modifications in the F4012 RP drift tube mesh, mesh spacing, and photocathode to effect improvements in linearity,

resolution, and photocathode uniformity. The deflection coil to be used with the tube was to be designed to improve off-axis linearity and resolution.

A summary of tube modifications and coil design is given in Appendix E. The effects of the changes are best indicated by examining the performance of the assembly with respect to the original design goals. It is noted that most of the tube and coil parameters are from the total assembly performance and are interdependent. Therefore, the performance of the tube with a deflection coil of different design or of the coil with an unimproved tube will not equal that of the improved assembly. An example of this is illustrated in Figures 1a and 1b of the Appendix E report.

Table 2-1 is a tabulation of the specification performance parameters and the measured performance on the two assemblies. The S/N 1 assembly is made up of the S/N 1 deflection coil and S/N 037403 image dissector. The S/N 2 assembly is made up of the S/N 2 deflection coil and S/N 037404 image dissector.

3.0 RECOMMENDATIONS

The results of S/N 1 assembly tests (Appendix F) suggest that further testing would be useful. Performance of one parameter (rise distance) did not improve as anticipated and additional modifications are necessary within the image dissector.

3.1 Additional Testing

Due to the lack of funds, no testing was performed at ITTG on the S/N 2 assembly. It is recommended that the Appendix F tests be performed on that assembly. Several additions or variations to specific sections of the test plan should be made.

Sec. 5.7 - Resolution - Following source-assembly alignment, this procedure will be run first. The effect on rise distance due to

a) dynode #1 and dynode #2 voltage

b) roll orinetation of tube in coil

c) using a larger optical image

will be checked.

Sec. 5.3 - 5.6 - Accuracy - These measurements will be made using optimum voltages and orientation from Sec. 5.7 tests.

Sec. 5.8 - Magnetic Field Effect - All tests will be run with $\pm$ 4 gauss fields including susceptibility to a longitudinal field.

Sec. 5.9 - Stability with Temperature - These tests will be run (not completed on S/N 1 assembly). However, the tube and coil should be encapsulated within the magnetic shields in order to get meaningful data.

3.2 Component Modification

The major deviation from the specification goals was the rise distance. It decreased little, if any, from that measured on previous designs. Two possible causes are 1) the scattered/reflected light from the mesh and 2) secondary emission of the mesh and/or aperture.

Most of the light photons are transmitted through the photocathode to the mesh. Some of these are reflected back to the photocathode causing additional electrons to be emitted. This effectively increases the electron beam size and rise distance. If this is the cause, a blackened mesh would be a desirable addition to future tubes.

Both the mesh and aperture plate are presently nickel plated. Use of a different metal having lower secondary emission properties (such as gold) could improve the rise distance. Additional analysis by the tube manufacturer is necessary to determine the merits of this change.

Upon examination of the rise distance data, the right measurement is always less than or equal to the left measurement. It is probable that this is caused by the tube. This could be due to either variations in the aperture sides or asymmetric electric fields near the aperture due to the first dynodes. The test plan changes outlined above (Sec. 5.7) should give some insight into why the rise distances are unequal.

TABLE 2-1

SPECIFICATION	S/N 1 ASSEMBLY	S/N 2 ASSEMBLY	APPENDIX NO	COMMENTS
Photocathode Uniformity 95% or greater over a 0.6 inch diameter	96.5 $\pm$ 3.5% measured	94 $\pm$ 6% measured	A & B	Typical spec is 95 $\pm$ 5% over a .56 inch diameter
Resolution: design goal is 4 microns at center and 6 microns at 0.3 inches from center	12 - 15 microns rise distance	not measured	F	Measurement is difficult to make in that the image size should be much smaller than the rise distance.
Radiant Sensitivity: high across S-20 bandwidth 20 ma/watt at 420 nm	50% more sensitive across band: 60 ma/watt at 420 nm	Typical across band: 43.67 ma/watt at 420 nm	A & B	
Aperture Size	0.008" x 0.008"	0.0078" x 0.0078"	A & B	This was changed from the original spec of 0.002" x 0.002"
Photocathode Luminous Sensitivity: 150 μa/lumen min.	258 μa/lumen	155 μa/lumen	A & B	Typical is 120 μa/lumen
Gain & Noise: Goal is to increase gain and decrease noise	gain = 5×10^5 at 1315 volts dark noise = $.7 \times 10^{-11}$ amps for 5×10^5 gain	gain = 5×10^5 at 1198 volts dark noise = 2.5×10^{-11} amps for 5×10^5 gain	A & B	Typical is 5×10^5 for 1200 volts Typical is 10^{-10} amps for 5×10^5 gain
Focus Coil: Shall be operable from a 20 volt supply drawing 50 ma/inch $\pm$ 50%	95 ma at 13 volts	95 ma at 13.5 volts	E & F	

TABLE 2-1 (Continued)

SPECIFICATION	S/N 1 ASSEMBLY	S/N 2 ASSEMBLY	APPENDIX No.	COMMENTS
Deflection Coil: sensitivity shall be 50 ma/inch ± 50%	Horizontal: Red-Blk 57 ma/inch Vertical: Wht-Grn 64 ma/inch	Horizontal: Red-Blk 60 ma/inch Vertical: Wht-Grn 66 ma/inch	E & F	
Linearity: shall be 0.25% with a design goal of 0.15% over 0.6 inch diameter Geometric Distortion: ± 0.15% Astigmatism: 0.25%	Horizontal - 0.2% Vertical - 0.15% RMS Radial distortion 0.00075 inches or .125% of 0.6 inch diameter	Not measured Not measured Not measured	F	Measurements are along X/Y axis Measurement considers all distortions - is a figure for absolute position accuracy
Magnetic Field Shield: Housing shall be such to minimize effect of external magnetic fields of ± 0.6 gauss	Max deflection of ± 0.0001 inch for transverse fields of ± 4. gauss	Not measured	F	Extrapolated to ± .6 gauss fields, the deflection would be ± 0.000015 inch or 1 part per 40,000. Shield configuration given in Appendix G
Divider network to be supplied	Supplied with hardware	Supplied with hardware	G	Schematic per Appendix G
Material shall be compatible with space environment	Coil, tube, shield and divider supplied as individual components. Coil assembly encapsulated with Shell EPON 828 per ITT AOD Process Specification 8007841.		G	

VIDISSECTOR IMAGE DISSECTOR TUBE TEST DATA

for

S/N 037403 (S/N 1 Assembly Component)

VIDISSECTOR® IMAGE DISSECTOR
TUBE TEST DATA

RADIANT SENSITIVITY[1]

Wavelgth nm	Sens. mA/watt	Q.E. %
408	58.95	18.04
455	62.4	17.16
513	62.14	15.16
553	57.07	12.89
613	42.59	8.68
653	38.93	7.43
694	33.48	6.06
719	31.55	5.49
792	24.48	3.86
888	2.73	.385

LUMINOUS SENSITIVITY

2854 K uA/lm	5113 uA/lm	2418 uA/lm
258	6.5	153

CUSTOMER ITT/GILFILLAN

PROJECT NO. 1452900

TUBE TYPE F4012RP

SERIAL NO. 037403

APERTURE .008 X .008

PHOTOCATHODE S20

TEST ACCEPTANCE

OPERATOR RB

DATE June 12, 1974

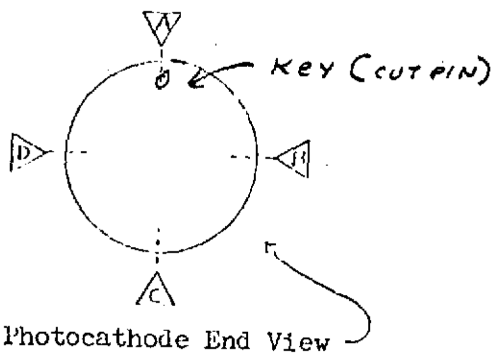
FACEPLATE/ENVELOPE
TOTAL INDICATED RUN-OUT

4.5 $\times 10^{-3}$ Inch At P. C. Edge

APERTURE SIZE

Measured .008 X .008

TUBE TEST ORIENTATION[3]



OPERATING VOLTAGES[2] AT 5×10^5 GAIN
(with respect to DT)

Photocathode -400 V

Dynode 1 0

Dynode 2 118

Dynode 3 225

Seperate Aperture NA

Seperate Mesh NA

Anode 1315

Anode, in respect to Dynode 12 14

1. Radiant Sensitivity plotted on page 4.
2. See recommended Voltage Divider on page 5.
3. Reference for Output Uniformity & Blemish photographs on page 2 & 3.

ITT Electro-Optical Products Div.
U. S. Patent No. 3,295,010

TUBE TYPE F4012RP

SERIAL NO. 037403 RB

MULT. GAIN AND DARK CURRENT

$A_{aper.}$ in^2	$A_{illum.}$ in^2	I_{pc} amp.	$I_{aper.}$ amp.	Gain	I_{anode} amp.	$E_{mult.}$ volts	I_{dark} amp.
6.4×10^{-5}	.39	4.7×10^{-8}	5×10^{-12}	1×10^5	5×10^{-7}	1055	2.1×10^{-11}
"	"	"	"	2×10^5	10×10^{-7}	1150	$.1 \times 10^{-11}$
"	"	"	"	5×10^5	2.5×10^{-6}	1315	$.7 \times 10^{-11}$
"	"	"	"	1×10^6	5×10^{-6}	1470	5×10^{-10}
"	"	"	"	2×10^6	10×10^{-6}	1670	15×10^{-7}

NOISE FACTOR

$A_{aper.}$ in^2	$A_{illum.}$ in^2	Gain	I_{pc} amp.	I_{anode} amp.	Noise E_{rms}	BW HZ	Noise Factor
6.4×10^{-5}	.39	5×10^5	1.9×10^{-8}	1×10^{-6}	100 mV	50K	1.93

OUTPUT UNIFORMITY

Horizontal Sweep Rate 5 ms/cm

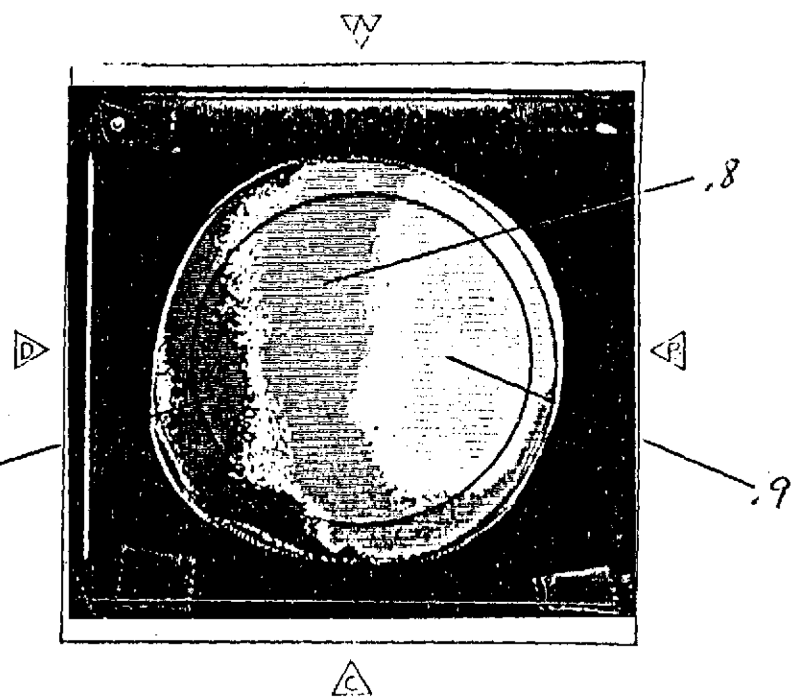
Vertical Sweep Rate 10 sec/frame

Contour Levels .9, .8, .7, .6, .4, .5

Photograph depicts 100 % of the full photocathode dia.

Output Uniformity is .7 over .56 inch (80%) photocathode quality diameter.

See "TUBE TEST ORIENTATION", page 1, to correlate the photographic data displayed below with the tube position.



ORIGINAL PAGE IS OF POOR QUALITY

TUBE TYPE F4012RP SERIAL NO. 037403 OPERATOR RB

SET #1 DATE ______ TEST ACCEPTANCE PAGE 2a RB

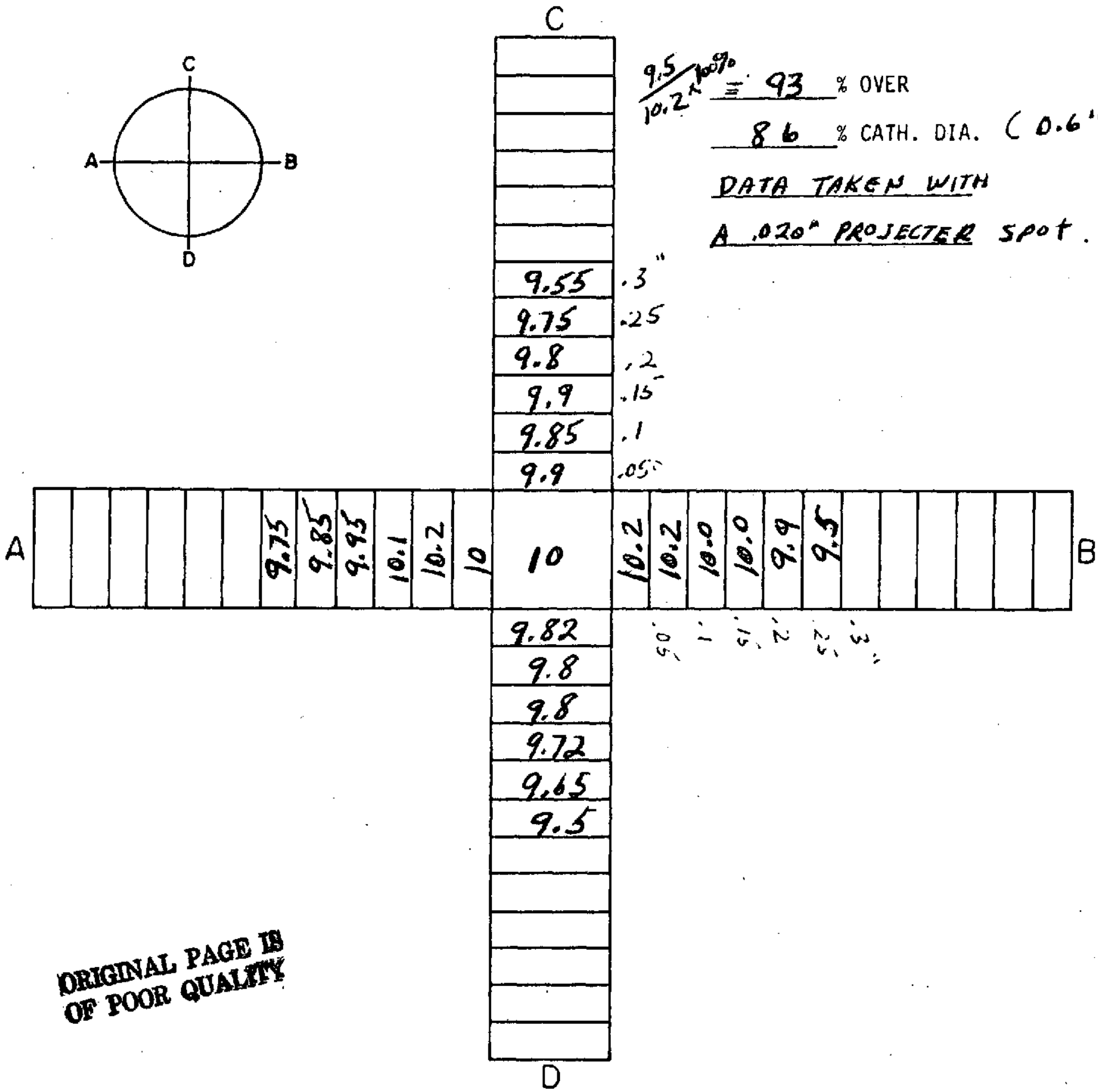
PHOTO CATHODE UNIFORMITY

$\frac{9.5}{10.2} \times 100\% \cong$ 93 % OVER

86 % CATH. DIA. (0.6")

DATA TAKEN WITH

A .020" PROJECTER SPOT.



TUBE TYPE F4012 RP

SERIAL NO. 037403

RESOLUTION

Horizontal Sweep Rate 20 ms/line

Anode Load 51 KΩ

Coil Type E4532

Focus I 61.75 mA

TVL/IN.	MODULATION AMPL. (%)
100	85
200	25
300	
400	
500	
600	
700	
800	

TVL/IN.	MODULATION AMPL. (%)
900	
1000	
1200	
1400	
1600	
1800	
2000	

BLEMISHES

See "TUBE TEST ORIENTATION", page 1, to correlate the photographic data displayed below with the tube position.

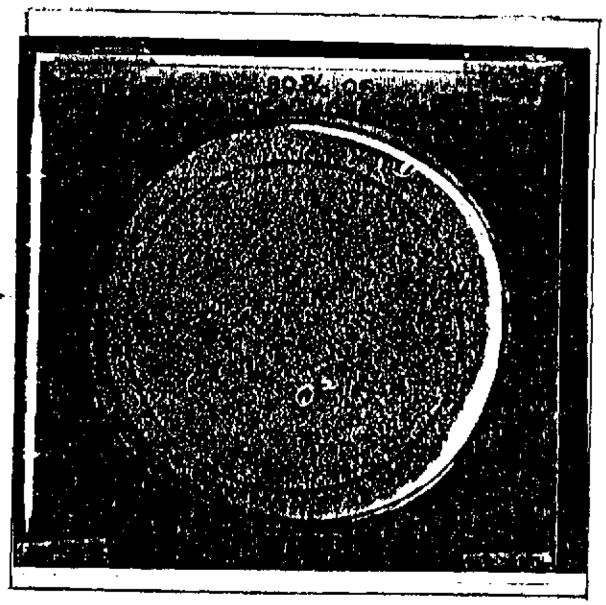
Horizontal Sweep Rate 5 ms/cm

Vertical Sweep Rate 50 sec/frame

Photograph depicts 100 % of the full photocathode dia.

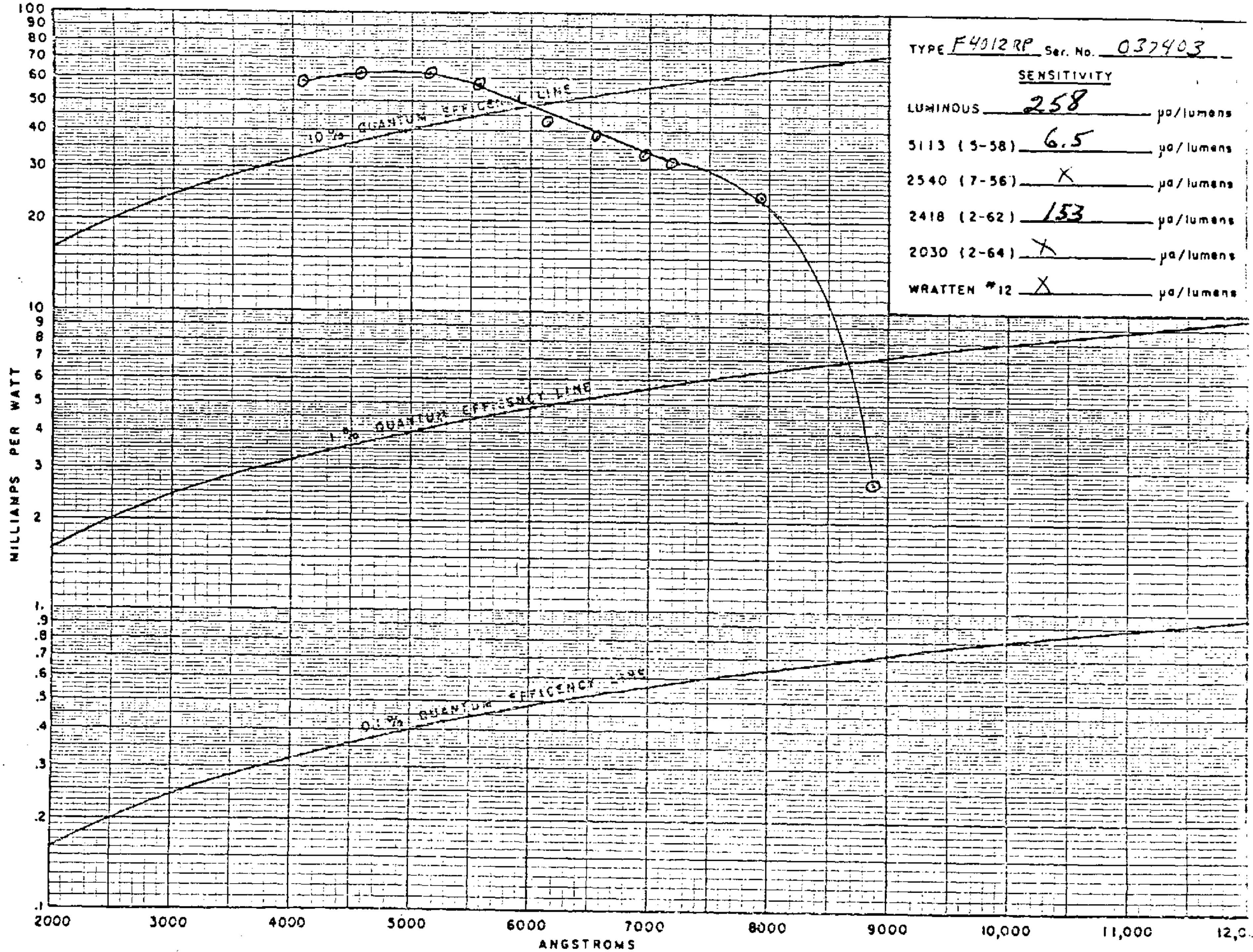
Blemish No.	Ampl. %	Width Inch	
1	25	.013	OUTSIDE 80% DIA
2	8	.003	

A



D B

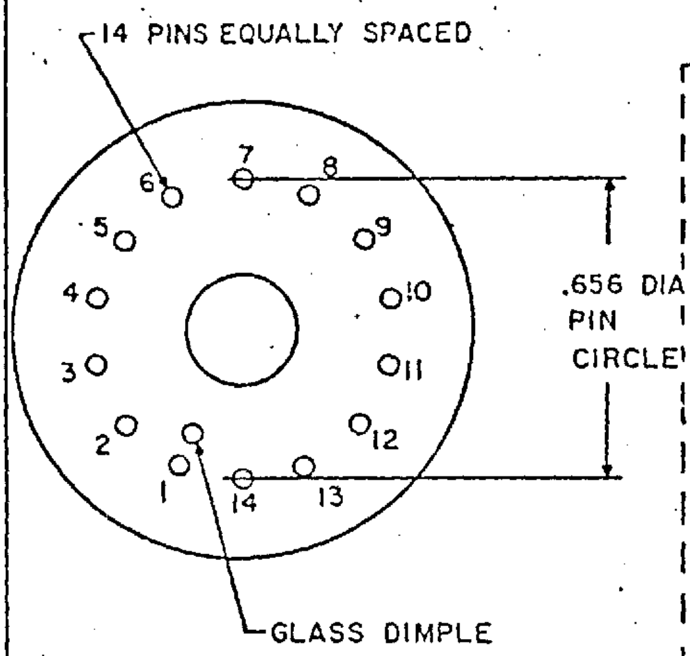
C


TYPE F4012 RP Ser. No. 037403
SENSITIVITY
LUMINOUS 258 μa/lumens
5113 (5-58) 6.5 μa/lumens
2540 (7-56) X μa/lumens
2418 (2-62) 153 μa/lumens
2030 (2-64) X μa/lumens
WRATTEN #12 X μa/lumens
10% QUANTUM EFFICIENCY LINE
1% QUANTUM EFFICIENCY LINE
0.1% QUANTUM EFFICIENCY LINE
MILLIAMPS PER WATT
ANGSTROMS
2000
3000
4000
5000
6000
7000
8000
9000
10,000
11,000

Appendix A - 4

F4012/F4012RP

STEMMING ARRANGEMENT

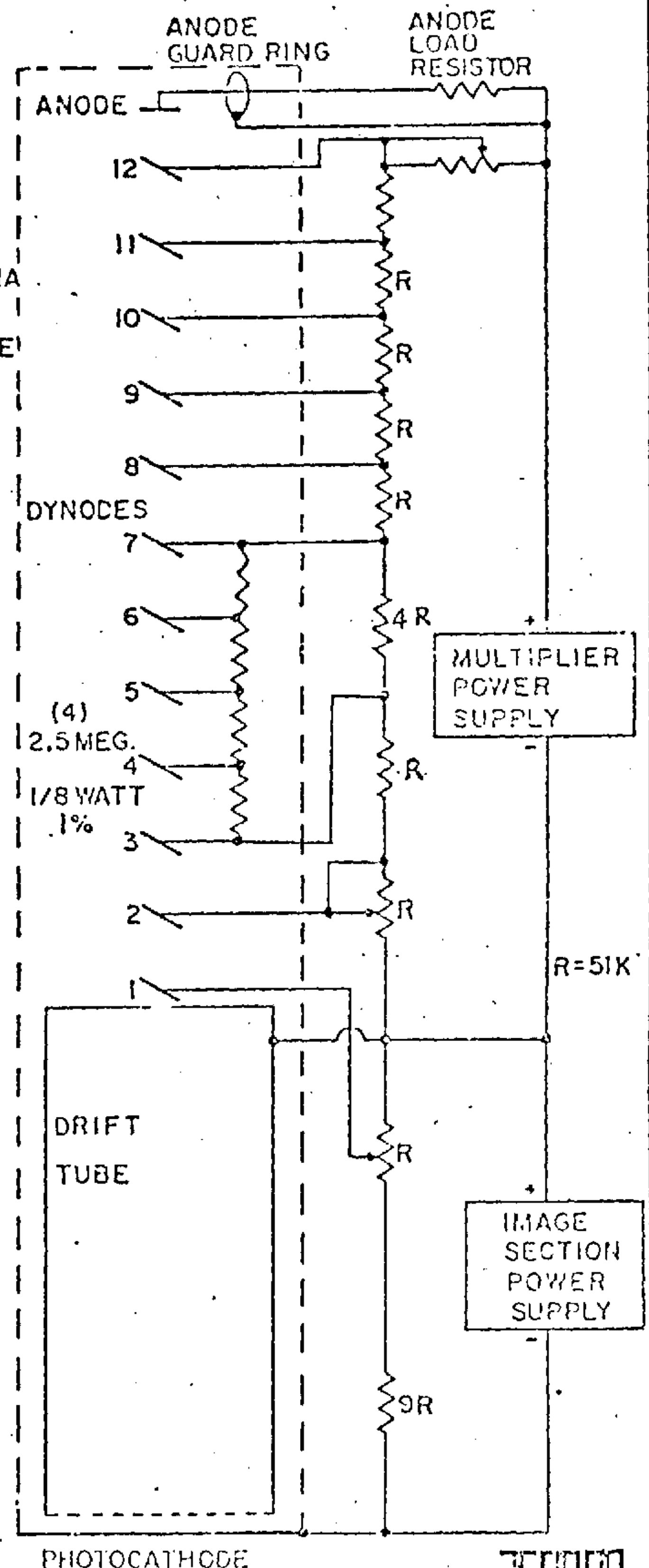


PIN	ELEMENT
1	DRIFT TUBE
2	DYNODE 8
3	DYNODE 1
4	DYNODE 2
5	DYNODE 3
6	DYNODE 10
7	INTERNAL CONNECTION
8	DYNODE 11
9	ANODE GUARD RING
10	ANODE
11	DYNODE 12
12	DYNODE 9
13	DYNODE 7
14	KEY PIN (CLIPPED)

FLYING LEAD – PHOTOCATHODE

VOLTAGE DIVIDER SCHEMATIC

(used for test)



ELECTRON TUBE DIVISION ITT

VIDISSECTOR IMAGE DISSECTOR TUBE TEST DATA

for

S/N 037404 (S/N 2 Assembly component)

VIDISSECTOR® IMAGE DISSECTOR

TUBE TEST DATA

CUSTOMER	ITT/GILFILLAN
PROJECT NO.	1452900
TUBE TYPE	F4012RP
SERIAL NO.	037404
APERTURE	.008 X .008
PHOTOCATHODE	S20
TEST	Acceptance Test
OPERATOR	RB
DATE	April 30, 1974

RADIANT SENSITIVITY[1]

Wavelgth nm	Sens. mA/watt	Q.E. %
408	43.67	13.36
455	43.83	12.05
513	40.25	9.82
553	37.06	8.37
613	28.16	5.74
653	24.74	4.72
694	20.0	3.62
719	17.19	2.99
792	9.18	1.45
888	.64	.09

LUMINOUS SENSITIVITY

2854 K uA/lm	5113 uA/lm	2418 uA/lm
155	4.8	80

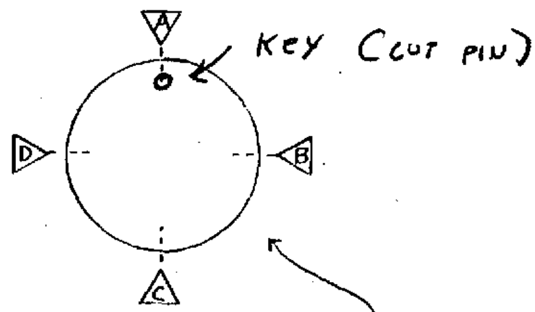
FACEPLATE/ENVELOPE
TOTAL INDICATED RUN-OUT

4.5 x 10^{-3} Inch At P. C. Edge

APERTURE SIZE

Measured .0078 X .0078

TUBE TEST ORIENTATION[3]



Photocathode End View

OPERATING VOLTAGES[2] AT 5×10^5 GAIN
(with respect to DT)

Photocathode	-400
Dynode 1	0
Dynode 2	106
Dynode 3	205

Seperate Aperture	NA
Seperate Mesh	NA
Anode	1198
Anode, in respect to Dynode 12	20

1. Radiant Sensitivity plotted on page 4.
2. See recommended Voltage Divider on page 5.
3. Reference for Output Uniformity & Blemish photographs on page 2 & 3.

ITT Electro-Optical Products Div.
U. S. Patent No. 3,295,010

TUBE TYPE F4012RP

SERIAL NO. 037404 RB

MULT. GAIN AND DARK CURRENT

$A_{aper.}$ in^2	$A_{illum.}$ in^2	I_{pc} amp.	$I_{aper.}$ amp.	Gain	I_{anode} amp.	$E_{mult.}$ volts	I_{dark} amp.
64×10^{-5}	.39	4.7×10^{-8}	5×10^{-12}	1×10^5	5×10^{-7}	980	$.8 \times 10^{-11}$
"	"	"	"	2×10^5	10×10^{-7}	1070	1.4×10^{-11}
"	"	"	"	5×10^5	2.5×10^{-6}	1198	2.5×10^{-11}
"	"	"	"	1×10^6	5×10^{-6}	1300	4×10^{-11}
"	"	"	"	2×10^6	10×10^{-6}	1425	8×10^{-11}

NOISE FACTOR

$A_{aper.}$ in^2	$A_{illum.}$ in^2	Gain	I_{pc} amp.	I_{anode} amp.	Noise E_{rms}	BW HZ	Noise Factor
64×10^{-5}	.39	5×10^5	1.95×10^{-8}	1×10^{-6}	100 mv	50 K	1.98

OUTPUT UNIFORMITY

See "TUBE TEST ORIENTATION", page 1, to correlate the photographic data displayed below with the tube position.

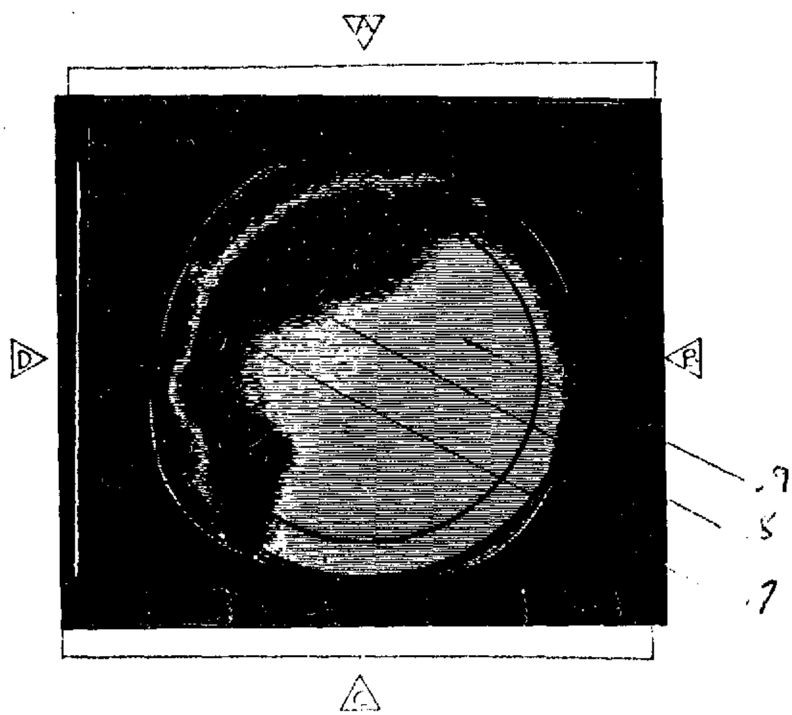
Horizontal Sweep Rate 5 ms/cm

Vertical Sweep Rate 10 sec/frame

Contour Levels .9, .8, .7, .6, .4.5

Photograph depicts 100 % of the full photocathode dia.

Output Uniformity is .8 over .56 inch (80%) photocathode quality diameter.



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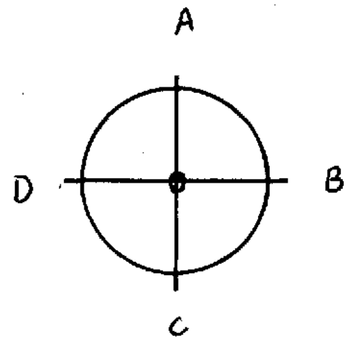
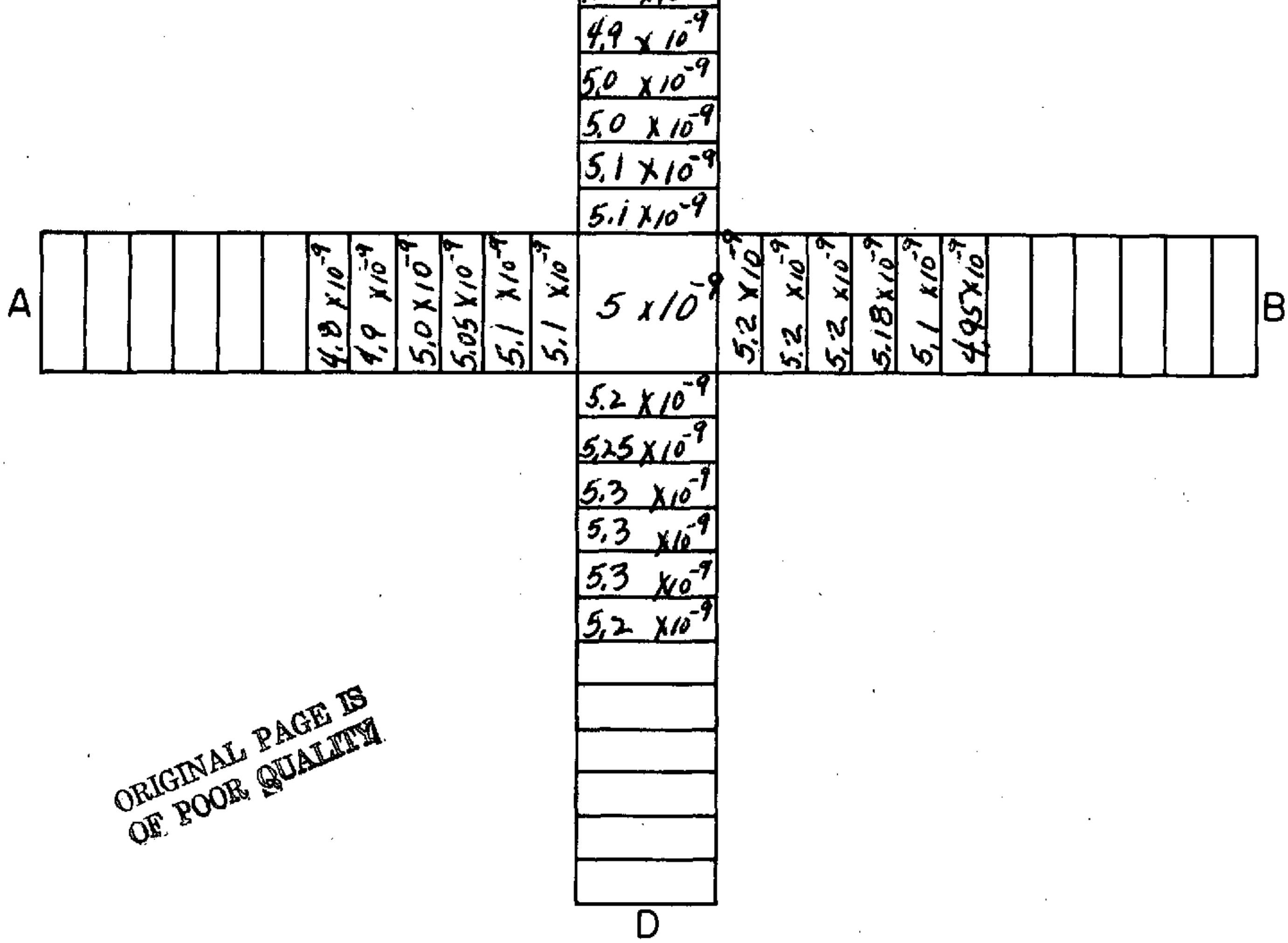
TUBE TYPE F4012RP SERIAL NO. 037404 OPERATOR RB & RH

SET #1 DATE 4/30/74 TEST acceptance PAGE 2a

X UNIFORMITY





$\frac{4.65}{5.3} \times 100\% =$ 88 % OVER

86 % CATH. DIA. (0.6")

DATA TAKEN WITH

.020" PROJECTED SPOT

TUBE TYPE F4012RP

SERIAL NO. 037404 RB

RESOLUTION

Horizontal Sweep Rate 20 ms/cm

Anode Load 51 KΩ

Coil Type F4532

61.22 ma

TVL/IN.	MODULATION AMPL. (%)
100	90
200	25
300	
400	
500	
600	
700	
800	

TVL/IN.	MODULATION AMPL. (%)
900	
1000	
1200	
1400	
1600	
1800	
2000	

BLEMISHES

See "TUBE TEST ORIENTATION", page 1, to correlate the photographic data displayed below with the tube position.

Horizontal Sweep Rate 5 ms/cm

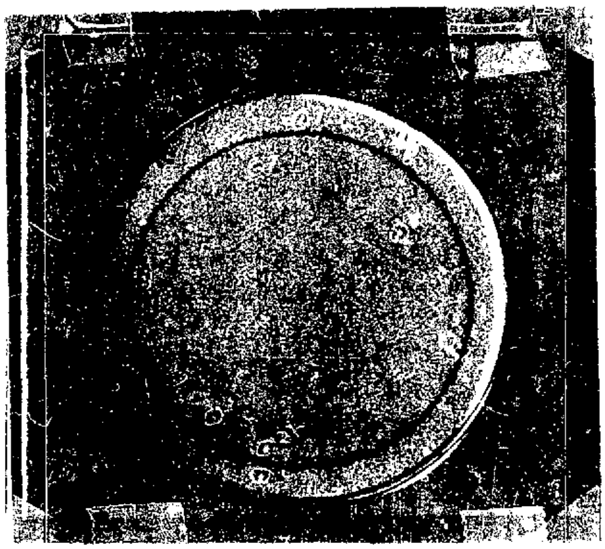
Vertical Sweep Rate 50 sec/frame

Photograph depicts 100 % of the full photocathode dia.

Blemish No.	Ampl. %	Width Inch	
1	10 BLK	.003	OUTSIDE 80% DIA.
2	8 BLK	.004	
3	8 BLK 5 WHT	.004 .003	
4	10 WHT	.004	
5	12 BLK	.0045	
6	8 BLK	.004	
7	5 BLK	.006	
8	35 BLK	.008	OUTSIDE 80% DIA.
9	8 BLK	.001	" "

A

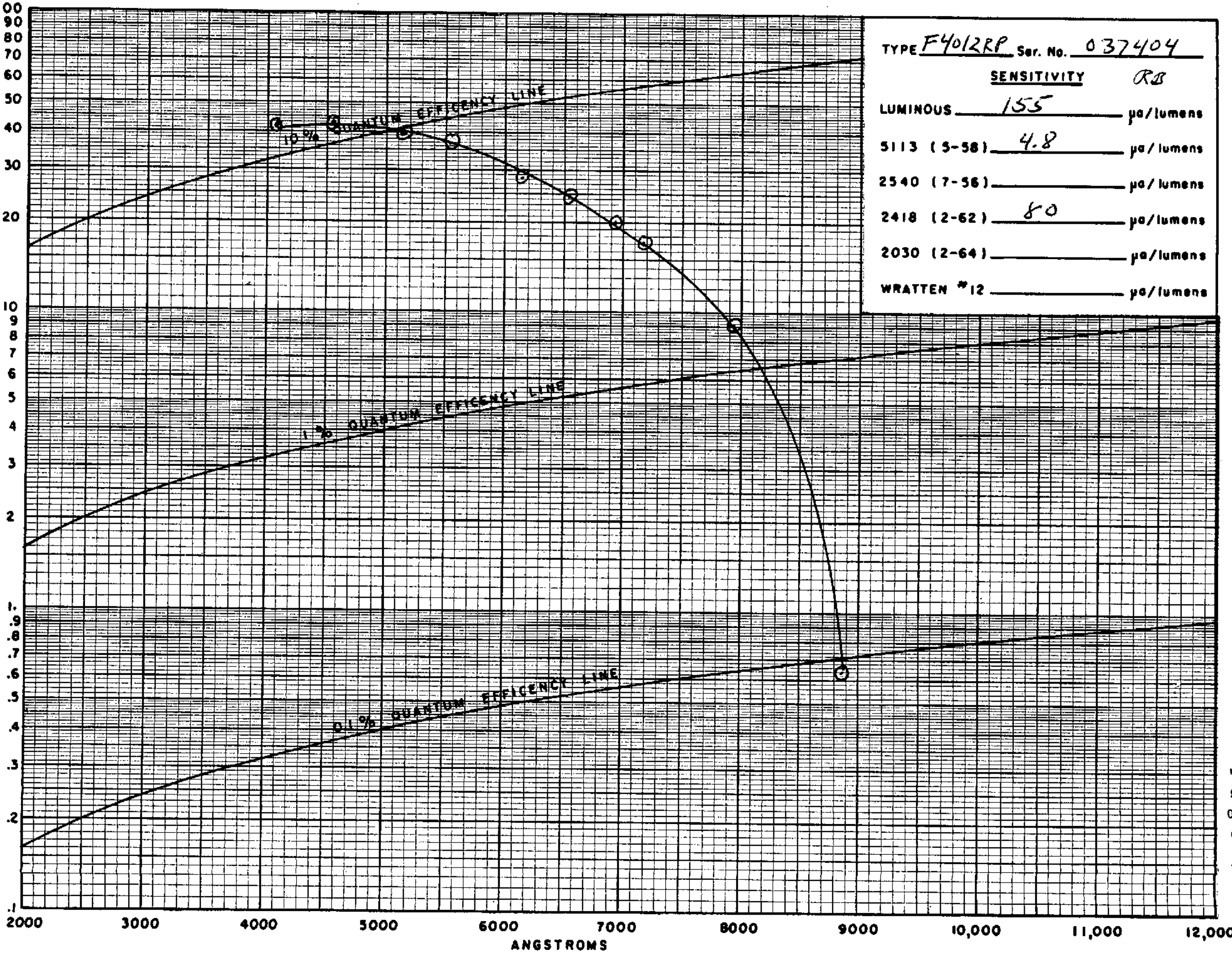
D



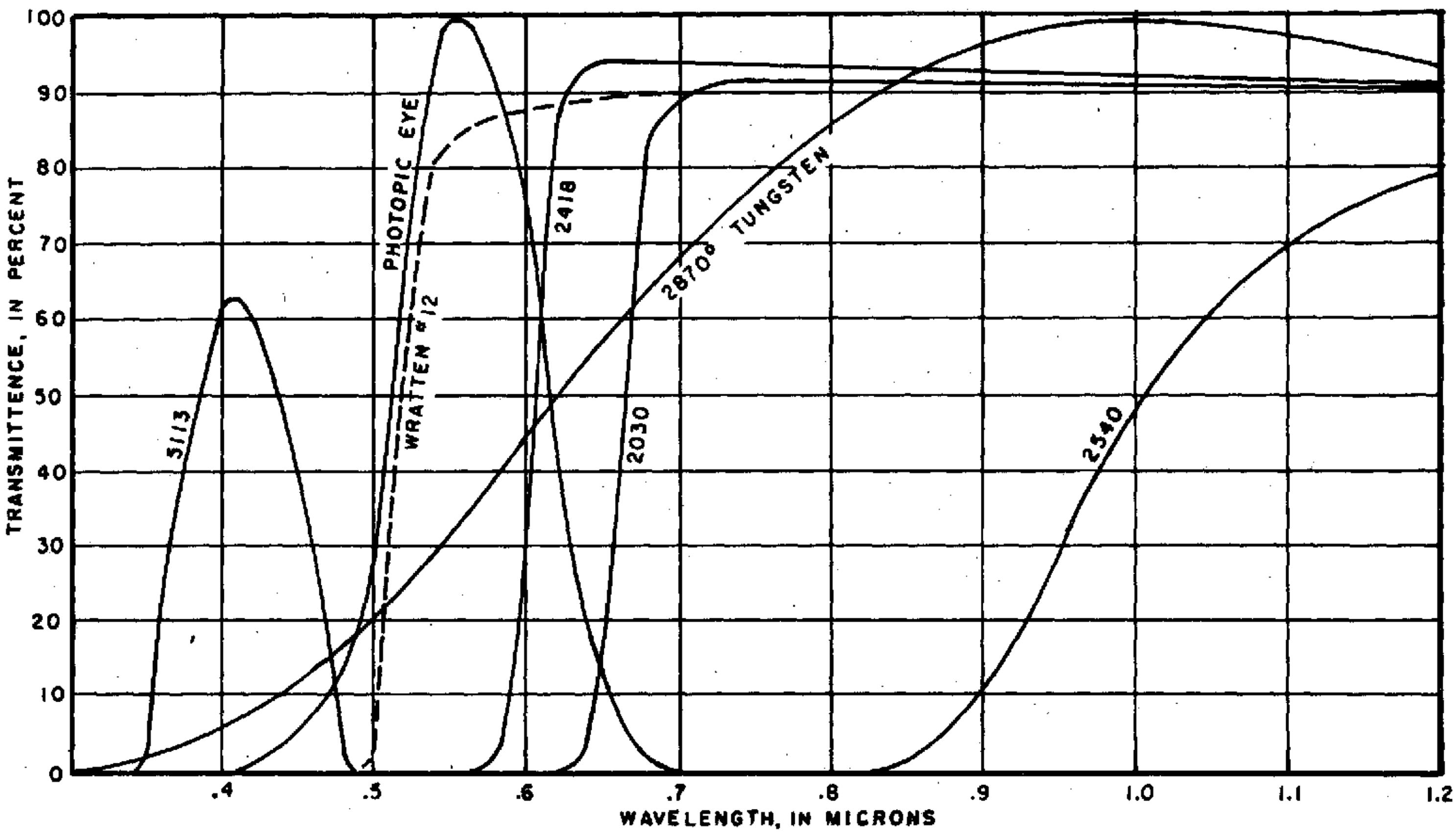
B

C

TTTII F-39a (6/66)



Appendix B - 4

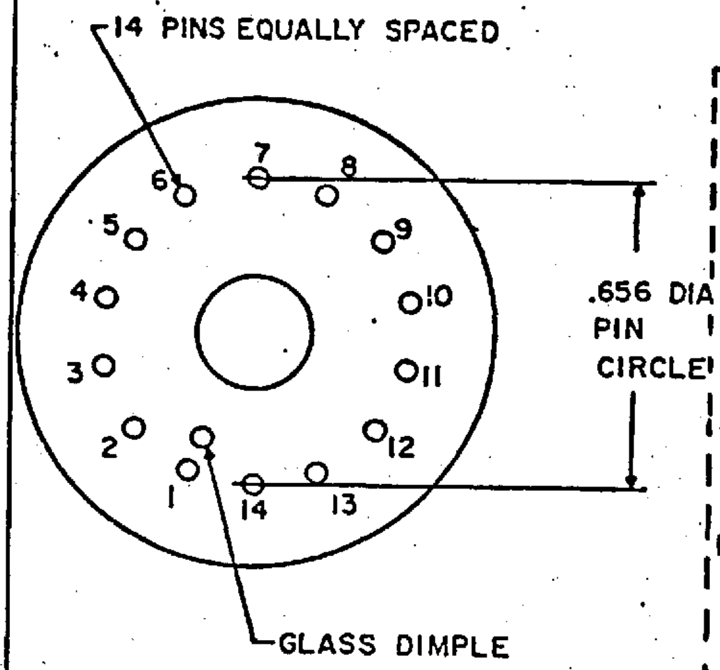


The standard luminous sensitivity is the response of the photocathode (in microamperes per lumen) to a tungsten lamp operating at 2870°K. The various numbered sensitivities are the response of the photocathode when Corning filters (filter numbers are four digits; dashed, three digit numbers in parentheses are a color specification number) of half stock thickness are interposed between the 2870°K lamp and the photocathode. Plotted above are the transmittance, in percent, of the filters, and the spectral distribution, in relative units, of 2870°K tungsten. Also shown are the photopic eye response and the transmission of a Wratten #12 filter.

ITTIL E-32b (6/66)

F4012/F4012RP

STEMMING ARRANGEMENT

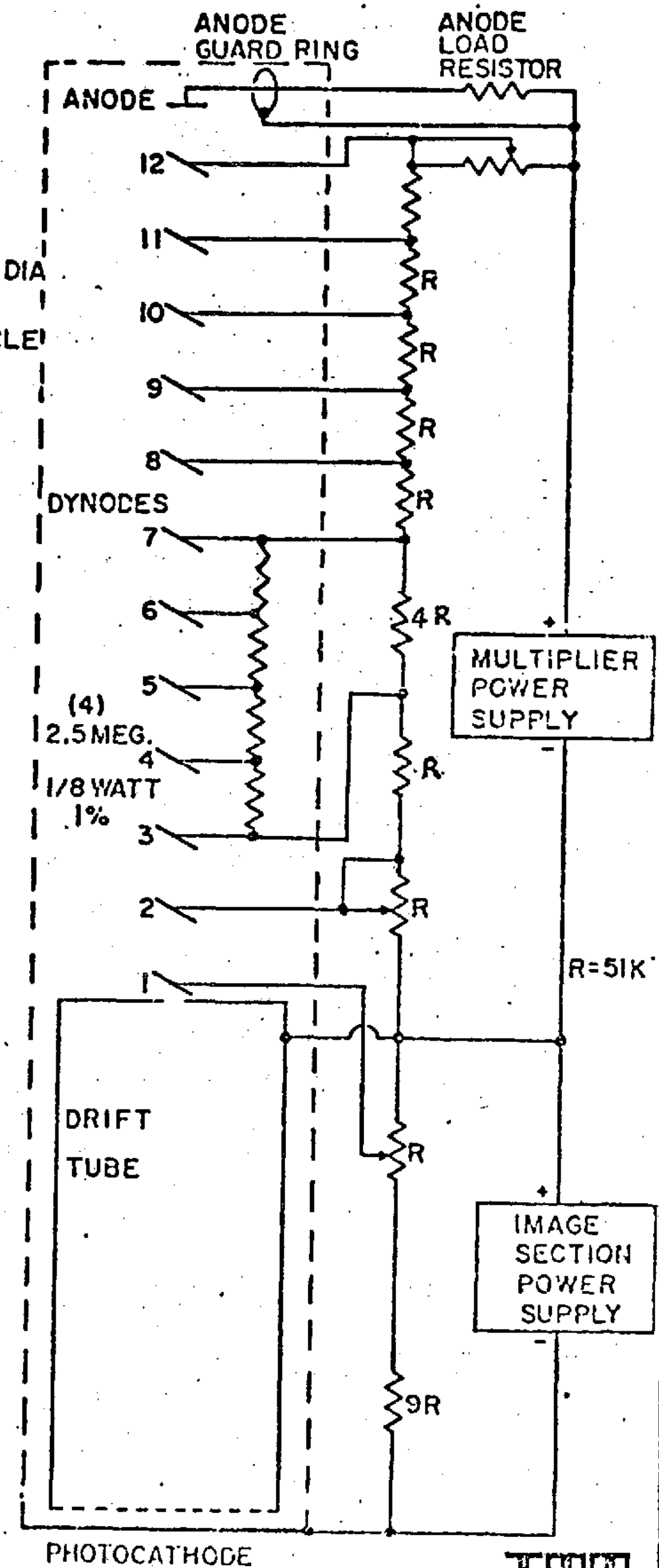


PIN	ELEMENT
1	DRIFT TUBE
2	DYNODE 8
3	DYNODE 1
4	DYNODE 2
5	DYNODE 3
6	DYNODE 10
7	INTERNAL CONNECTION
8	DYNODE 11
9	ANODE GUARD RING
10	ANODE
11	DYNODE 12
12	DYNODE 9
13	DYNODE 7
14	KEY PIN (CLIPPED)

FLYING LEAD – PHOTOCATHODE

VOLTAGE DIVIDER SCHEMATIC

(used for test)



ELECTRON TUBE DIVISION ITT

F4012 RP DEFLECTION ASSEMBLY TEST DATA

Model 8008946

S/N 1 (S/N 1 Assembly Component)

- F4012RP DEFLECTION ASSEMBLY TEST DATA -

MODEL 8007846-1 S/N 1 DATE 6-5-74

MECHANICAL

Length	5.485	Inches
Outside diameter	2.265	Inches
Bore diameter	1.135	Inches
Weight	0.942	Kg.
Focus Current *	97	mA
Deflection Sensitivity * (.4 x .4 inch square)		
Horizontal (inner)	60.1	mA/inch
Vertical (outer)	69.9	mA/inch
Geometrical Distortion * (.4 x .4 inch square)		
Horizontal RMS (inner)	5.6×10^{-4}	Inches
Vertical RMS (outer)	5.6×10^{-4}	Inches
Worst point coordinates (.2, .2)		
magnitude of error	1.72×10^{-3}	Inches
SKEW +y AXIS cw toward +X AXIS	-.3 degrees	

* Assumes 400V, 1 loop, modified F4012RP.

F4012RP S/N 037404

H J Myers
6/13/74

ITTFL 20

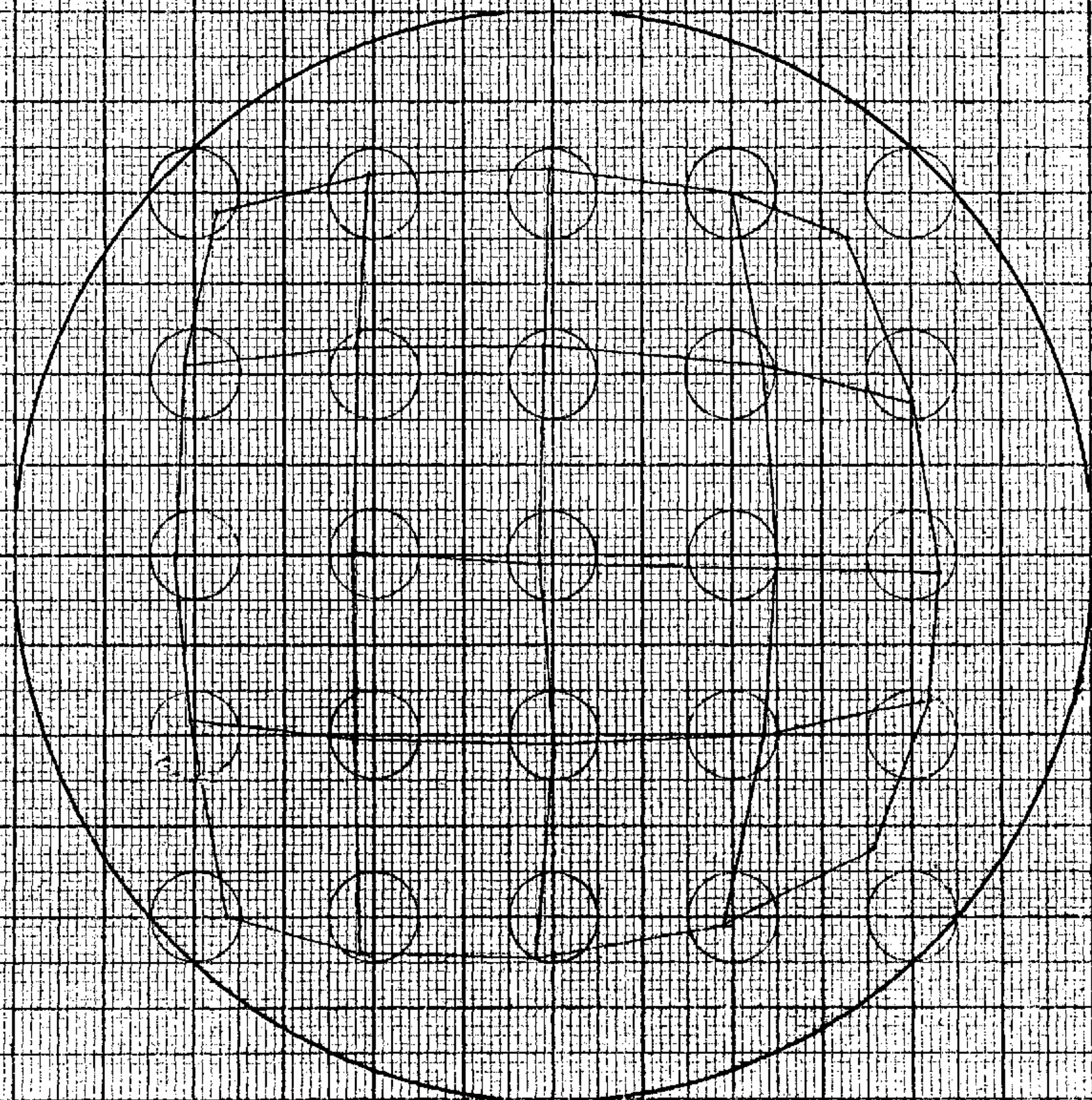
DRAWING NUMBER 8007847

REV

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

DWG SIZE	CODE IDENT NO.	
A	31550	8007847
SCALE		SHEET 4 of 4

8007846-1 S/N 1



6-5-74 -1 DATA
F4012RP (S20, BS) (37404)
3/8" POSITION
After final Assy
& ENCAPSULATION

8007846-1 S/N1 6-5-74

+Y AXIS IS SKEWED -.29[illegible] DEGREES CW TOWARD THE +X AXIS

X POSITION	Y POSITION	X CALCULATED	ABS(X POS) -ABS(X CAL)	
Ø	Ø	-2.51465E-Ø4	-2.51465E-Ø4	
.1	Ø	9.89544E-Ø2	1.Ø456ØE-Ø3	*****
.1	.1	9.93Ø92E-Ø2	6.9Ø788E-Ø4	
Ø	.1	-1.88586E-Ø4	-1.88586E-Ø4	
-.1	.1	-9.96166E-Ø2	3.83377E-Ø4	
-.1	Ø	-9.9535ØE-Ø2	4.64976E-Ø4	
-.1	-.1	-9.95899E-Ø2	4.1ØØ8ØE-Ø4	
Ø	-.1	-4.17Ø53E-Ø5	-4.17Ø53E-Ø5	
.1	-.1	9.934Ø2E-Ø2	6.59749E-Ø4	
.2	-.1	.19956	4.39495E-Ø4	
.2	Ø	.199374	6.25789E-Ø4	
.2	.1	.199974	2.58386E-Ø5	
.2	.2	.2Ø14Ø3	-1.4Ø315E-Ø3	*****
.1	.2	.1ØØØ24	-2.44528E-Ø5	
Ø	.2	-5.78544E-Ø5	-5.78544E-Ø5	
-.1	.2	-9.993Ø2E-Ø2	6.9797ØE-Ø5	
-.2	.2	-.2ØØ544	-5.43833E-Ø4	
-.2	.1	-.199752	2.475Ø8E-Ø4	
-.2	Ø	-.199596	4.Ø4418E-Ø4	
-.2	-.1	-.199922	7.76947E-Ø5	
-.2	-.2	-.2ØØ744	-7.44462E-Ø4	
-.1	-.2	-9.97396E-Ø2	2.6Ø413E-Ø4	
Ø	-.2	3.73117E-Ø4	-3.73117E-Ø4	
.1	-.2	.1ØØ247	-2.46793E-Ø4	
.2	-.2	.2ØØ949	-9.49144E-Ø4	

X POSITION	Y POSITION	Y CALCULATED	ABS(Y POS) -ABS(Y CAL)	
Ø	Ø	1.73Ø32E-Ø4	-1.73Ø32E-Ø4	
.1	Ø	2.97Ø23E-Ø4	-2.97Ø23E-Ø4	
.1	.1	9.97843E-Ø2	2.15694E-Ø4	
Ø	.1	9.94312E-Ø2	5.68762E-Ø4	
-.1	.1	9.939Ø3E-Ø2	6.Ø9726E-Ø4	
-.1	Ø	-1.1Ø842E-Ø5	-1.1Ø842E-Ø5	
-.1	-.1	-9.99192E-Ø2	8.Ø7643E-Ø5	
Ø	-.1	-9.97666E-Ø2	2.33397E-Ø4	
.1	-.1	-9.99976E-Ø2	2.35438E-Ø6	
.2	-.1	-.1ØØ758	-7.583Ø5E-Ø4	
.2	Ø	4.15331E-Ø4	-4.15331E-Ø4	
.2	.1	.1ØØ553	-5.52535E-Ø4	
.2	.2	.2Ø1ØØ2	-1.ØØ186E-Ø3	*****
.1	.2	.2ØØØØ5	-4.55976E-Ø6	
Ø	.2	.199488	5.11736E-Ø4	
-.1	.2	.199613	3.86655E-Ø4	
-.2	.2	.2ØØ443	-4.42713E-Ø4	
-.2	.1	9.9753ØE-Ø2	2.47Ø17E-Ø4	
-.2	Ø	-5.45377E-Ø7	-5.45377E-Ø7	
-.2	-.1	-.1ØØ318	-3.18155E-Ø4	
-.2	-.2	-.199974	2.563ØØE-Ø5	
-.1	-.2	-.199192	8.Ø82Ø9E-Ø4	
Ø	-.2	-.199Ø93	9.Ø6497E-Ø4	
.1	-.2	-.1998Ø8	1.91599E-Ø4	
.2	-.2	-.2Ø15Ø8	-1.5Ø815E-Ø3	*****

ORIGINAL PAGE IS OF POOR QUALITY

THE RMS X ERROR IS 5.57164E-Ø4

THE RMS Y ERROR IS 5.6Ø285E-Ø4

READY

8007846-1 SW1 6-13-74

+Y AXIS IS SKEWED -5.38155E-02 DEGREES CW TOWARD THE +X AXIS

X POSITION	Y POSITION	X CALCULATED	ABS(X POS) -ABS(X CAL)	
Ø	Ø	-2.08131E-Ø5	-2.Ø8131E-Ø5	
.1	Ø	9.91777E-Ø2	8.22246E-Ø4	
.1	.1	9.94131E-Ø2	5.86942E-Ø4	
Ø	.1	3.99Ø83E-Ø5	-3.99Ø83E-Ø5	
-.1	.1	-9.936Ø7E-Ø2	6.39245E-Ø4	
-.1	Ø	-9.92728E-Ø2	7.272Ø6E-Ø4	
-.1	-.1	-9.94719E-Ø2	5.28112E-Ø4	
Ø	-.1	3.62184E-Ø5	-3.62184E-Ø5	
.1	-.1	9.94676E-Ø2	5.32389E-Ø4	
.2	-.1	.199633	3.66747E-Ø4	
.2	Ø	.199223	7.76857E-Ø4	
.2	.1	.1996Ø6	3.93569E-Ø4	
.2	.2	.2ØØ815	-8.15421E-Ø4	
.1	.2	.1ØØØ53	-5.28544E-Ø5	
Ø	.2	1.48543E-Ø4	-1.48543E-Ø4	
-.1	.2	-9.97913E-Ø2	2.Ø8691E-Ø4	
-.2	.2	-.2ØØ798	-7.98Ø47E-Ø4	
-.2	.1	-.199821	1.79Ø23E-Ø4	
-.2	Ø	-.19959	4.1ØØ5ØE-Ø4	
-.2	-.1	-.2ØØØ39	-3.91ØØ6E-Ø5	
-.2	-.2	-.2Ø116	-1.16Ø2ØE-Ø3	*****
-.1	-.2	-9.99733E-Ø2	2.67178E-Ø5	
Ø	-.2	2.32915E-Ø4	-2.32915E-Ø4	
.1	-.2	.1ØØ337	-3.36543E-Ø4	
.2	-.2	.2Ø1116	-1.11562E-Ø3	*****

X POSITION	Y POSITION	Y CALCULATED	ABS(Y POS) -ABS(Y CAL)	
Ø	Ø	2.31Ø26E-Ø4	-2.31Ø26E-Ø4	
.1	Ø	2.383Ø6E-Ø4	-2.383Ø6E-Ø4	
.1	.1	9.97411E-Ø2	2.58848E-Ø4	
Ø	.1	9.95ØØ1E-Ø2	4.999Ø4E-Ø4	
-.1	.1	9.95568E-Ø2	4.43235E-Ø4	
-.1	Ø	1.Ø6Ø92E-Ø4	-1.Ø6Ø92E-Ø4	
-.1	-.1	-.1ØØØ81	-8.Ø958ØE-Ø5	
Ø	-.1	-9.98726E-Ø2	1.27375E-Ø4	
.1	-.1	-.1ØØØ79	-7.8544ØE-Ø5	
.2	-.1	-.1ØØ836	-8.35747E-Ø4	
.2	Ø	1.96911E-Ø4	-1.96911E-Ø4	
.2	.1	.1ØØ276	-2.7585ØE-Ø4	
.2	.2	.2ØØ9Ø1	-9.ØØ865E-Ø4	
.1	.2	.199918	8.16286E-Ø5	
Ø	.2	.199422	5.78225E-Ø4	
-.1	.2	.199639	3.6Ø936E-Ø4	
-.2	.2	.2ØØ712	-7.12246E-Ø4	
-.2	.1	.1ØØØ23	-2.34395E-Ø5	
-.2	Ø	1.23859E-Ø4	-1.23859E-Ø4	
-.2	-.1	-.1ØØ652	-6.51851E-Ø4	
-.2	-.2	-.2ØØ343	-3.42846E-Ø4	
-.1	-.2	-.19934	6.59823E-Ø4	
Ø	-.2	-.198999	1.ØØ112E-Ø3	*****
.1	-.2	-.199487	5.12719E-Ø4	
.2	-.2	-.2ØØ897	-8.97Ø2ØE-Ø4	

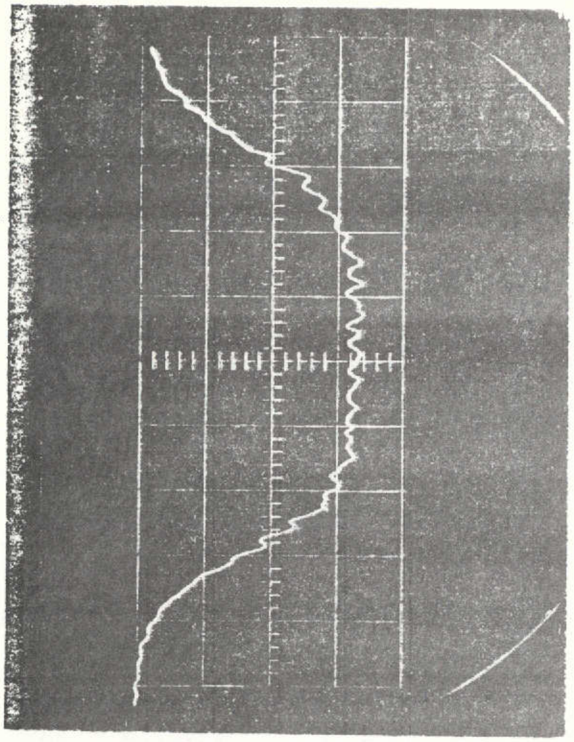
THE RMS X ERROR IS 5.68165E-Ø4

THE RMS Y ERROR IS 5.13594E-Ø4

READY

ORIGINAL PAGE IS OF POOR QUALITY

RUN
THIS IS 6/13/74-1 DATA. THE TUBE IS A F4Ø12RP(S2Ø,8S).
THE TUBE S/N IS Ø374Ø3. THIS IS THE SECOND TUBE IN THE
FIRST DEFLECTION ASSEMBLY.



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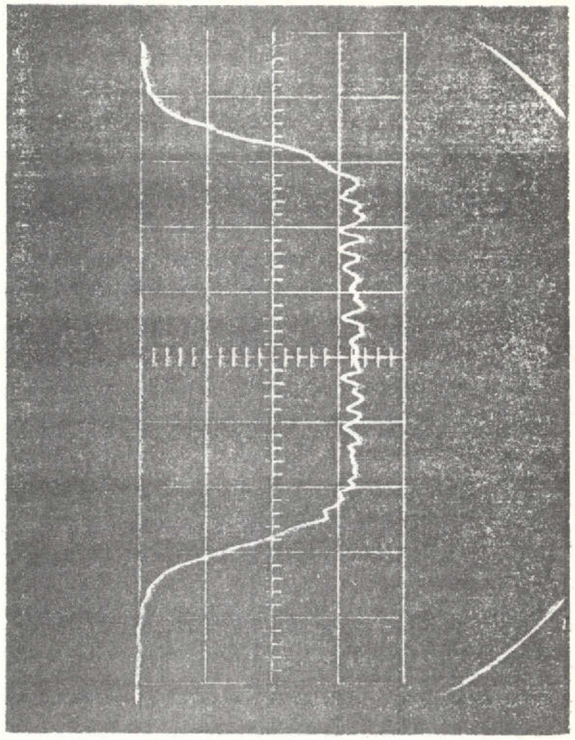
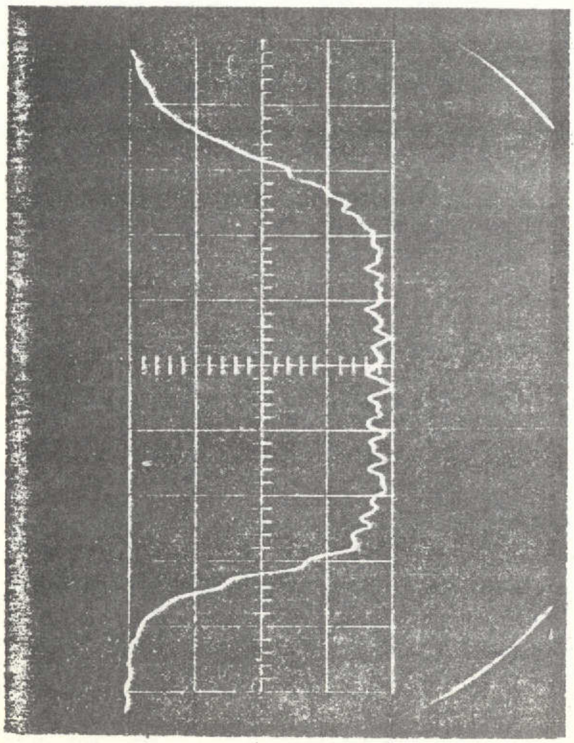
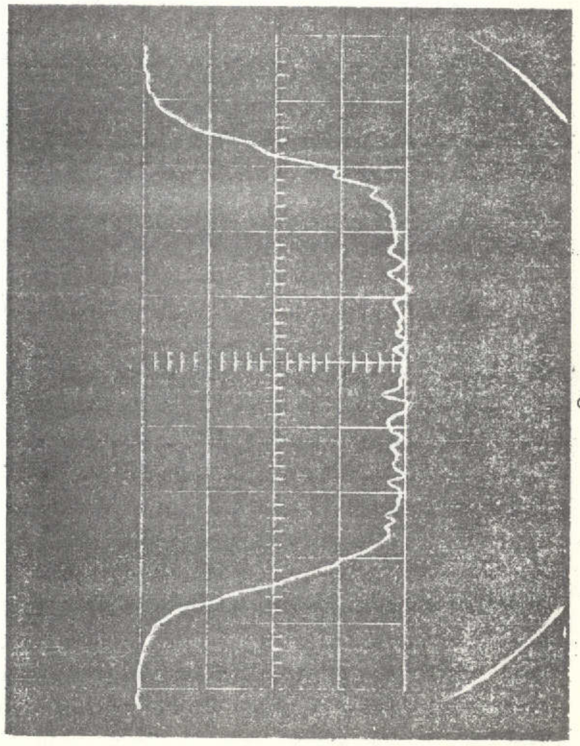


4



1



3

2

+.2, +.2 .001" spot of light

I_f = 97mA

pulse is ~.009" wide at 10% points

8007846-1 S/N 1
5/6/74
F4012RP 37404

4

+.2, +.2 .001" spot of light

I_f = 95.5mA (optimum)

pulse is ~.009" wide at 10% points

8007846-1 S/N 1
5/6/74
F4012RP 37404

1

Center .001" spot of light

I_f = 95.5mA

pulse is ~.009" wide at 10% points

8007846-1 S/N 1
6/5/74
F4012RP 37404

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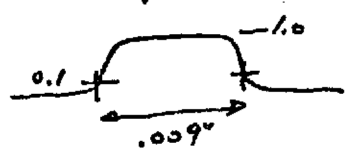
OF POOR QUALITY

3

Center .001" spot of light

I_f = 97mA (optimum)

Pulse is ~.009" wide at 10% points



8007846-1 S/N 1
6/5/74
F4012RP 37404

F4012 RP DEFLECTION ASSEMBLY TEST DATA

Model 8008946

S/N 2 (S/N 2 Assembly Component)

REV

DRAWING NUMBER 8007847

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

- F4012RP DEFLECTION ASSEMBLY TEST DATA -

MODEL 8007846-1 S/N 2 DATE 8-2-74

MECHANICAL

Length	5.490	Inches
Outside diameter	2.265	Inches
Bore diameter	1.135	Inches
Weight	0.945	Kg
Focus Current *	95	mA
Deflection Sensitivity * (.4 x .4 inch square)		
Horizontal (inner)	60.1	mA/inch
Vertical (outer)	65.9	mA/inch
Geometrical Distortion * (.4 x .4 inch square)		
Horizontal RMS (inner)	5.0×10^{-4}	Inches
Vertical RMS (outer)	5.2×10^{-4}	Inches
Worst point coordinates (.2, .2)		
magnitude of error	1.5×10^{-3}	Inches

SKEW: +y AXIS CW TOWARD +x AXIS 0.44 Degrees

* Assumes 400V, 1 loop, modified F4012RP.

F4012RP (S70, 85) 37404

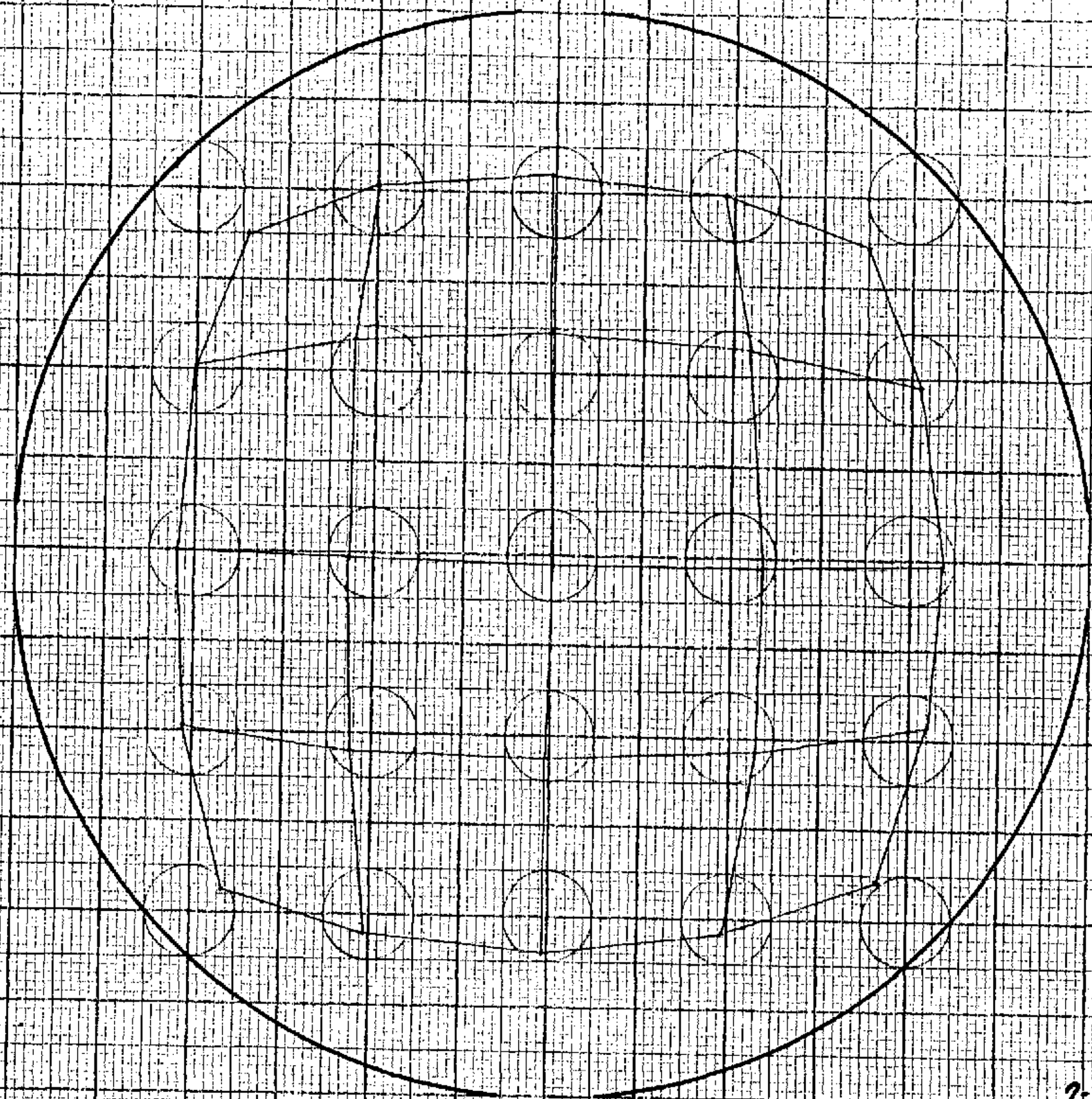
H J Myers
8/2/74

ITTFL 20

DWG SIZE	CODE IDENT NO.	
A	31550	8007847
SCALE		SHEET 4 of 4

FORM NO. FW ITTAOD D 102

LINCOLN-GRAPHIC CORP. 10 5155 4M 4-70



7-31-74-1 DATA
F4012RP(S20, 880)
37404
SN 2

RUN
THIS IS 73174-1 DATA.TUBE IS F 4012RP (S20,SS),S/N037404.
POST POT DATA.

YOKE AXES ROTATED .731752 DEGREES CW.

+Y AXIS IS SKEWED .445546 DEGREES CW TOWARD THE +X AXIS

X POSITION	Y POSITION	X CALCULATED	ABS(X POS) -ABS(X CAL)	
0	0	1.97399E-05	-1.97399E-05	
.1	0	9.93366E-02	6.63385E-04	
.1	.1	9.96399E-02	3.60057E-04	
0	.1	8.64226E-05	-8.64226E-05	
-.1	.1	-9.95082E-02	4.91813E-04	
-.1	0	-9.93597E-02	6.40288E-04	
-.1	-.1	-9.94798E-02	5.20155E-04	
0	-.1	5.47609E-05	-5.47609E-05	
.1	-.1	9.94499E-02	5.50121E-04	
.2	-.1	.199569	4.31329E-04	
.2	0	.199308	6.92338E-04	
.2	.1	.199789	2.11358E-04	
.2	.2	.200985	-9.85473E-04	
.1	.2	.100217	-2.17050E-04	
0	.2	9.30694E-05	-9.30694E-05	
-.1	.2	-.100015	-1.53035E-05	
-.2	.2	-.201087	-1.08701E-03	*****
-.2	.1	-.20001	-1.03712E-05	
-.2	0	-.199571	4.28557E-04	
-.2	-.1	-.199821	1.79350E-04	
-.2	-.2	-.200708	-7.08103E-04	
-.1	-.2	-9.98581E-02	1.41844E-04	
0	-.2	1.46852E-04	-1.46852E-04	
.1	-.2	.100068	-6.84559E-05	
.2	-.2	.200655	-6.55413E-04	

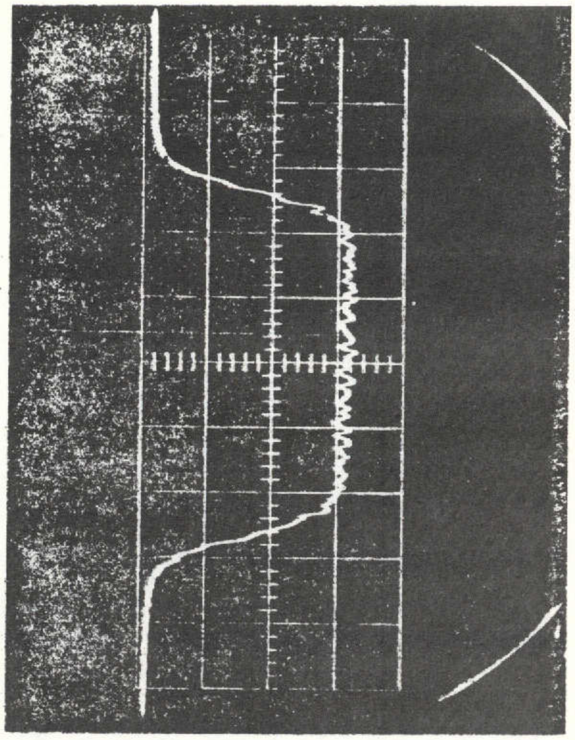
X POSITION	Y POSITION	Y CALCULATED	ABS(Y POS) -ABS(Y CAL)	
0	0	-2.27440E-04	-2.27440E-04	
.1	0	-1.85615E-04	-1.85615E-04	
.1	.1	9.93619E-02	6.38112E-04	
0	.1	9.91411E-02	8.58933E-04	
-.1	.1	9.93308E-02	6.69196E-04	
-.1	0	-8.61939E-05	-8.61939E-05	
-.1	-.1	-9.96210E-02	3.79011E-04	
0	-.1	-9.95062E-02	4.93780E-04	
.1	-.1	-9.96932E-02	3.06770E-04	
.2	-.1	-.100255	-2.54557E-04	
.2	0	1.20610E-04	-1.20610E-04	
.2	.1	.100197	-1.97142E-04	
.2	.2	.201084	-1.08388E-03	*****
.1	.2	.200044	-4.44651E-05	
0	.2	.199588	4.11510E-04	
-.1	.2	.199861	1.38819E-04	
-.2	.2	.200967	-9.66966E-04	
-.2	.1	9.98518E-02	1.48192E-04	
-.2	0	2.08544E-05	-2.08544E-05	
-.2	-.1	-.100104	-1.04383E-04	
-.2	-.2	-.200525	-5.24640E-04	
-.1	-.2	-.199562	4.37707E-04	
0	-.2	-.199226	7.73847E-04	
.1	-.2	-.199679	3.21478E-04	
.2	-.2	-.200899	-8.99136E-04	

THE RMS X ERROR IS 4.96559E-04

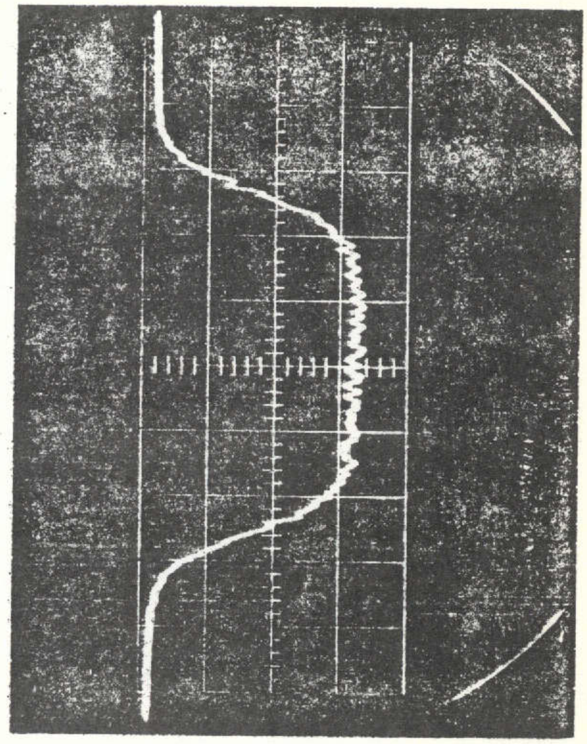
THE RMS Y ERROR IS 5.24299E-04

READY

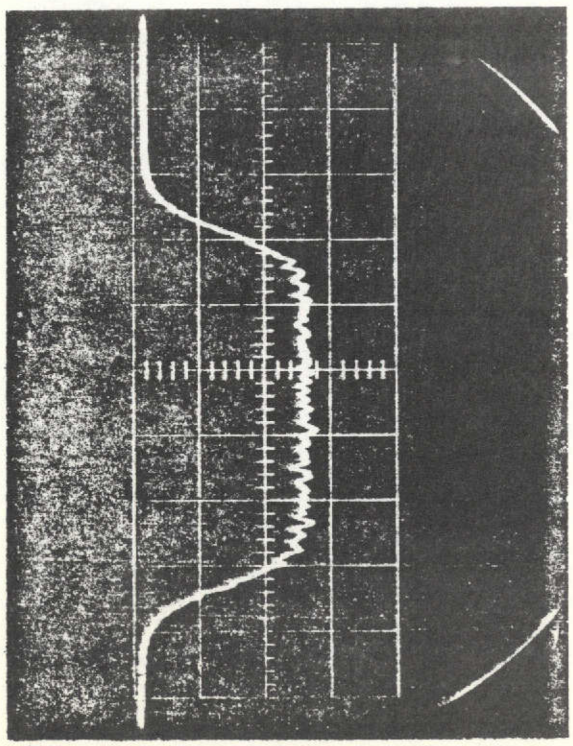
ORIGINAL PAGE IS OF POOR QUALITY



1



2



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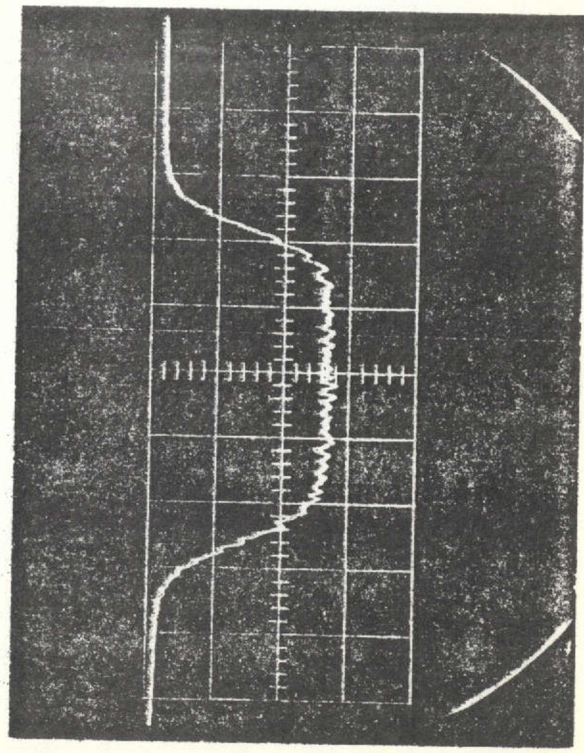


4

#
1

CENTER .001" spot w/ lite

I_f = 95mA (optimum)

Pulse is ~.005" wide at 10% points

8007846-1 S/N 2
8/2/74
F4012RP 37404

#
2

x = +.2
y = +.2
I_f = 95mA

8007846-1 S/N 2
8/2/74
F4012RP (37404)

#

3

x = +.2
y = +.2
I_f = 94 mA (optimum)

8007846-1 S/N 2
8/2/74
F4012RP 37404

#
4

x = .0
y = .0 (CENTER)
I_f = 94 mA

8007846-1 S/N 2
8/2/74
F4012RP 37404

FINAL REPORT

"Improved F4012 Image Dissector Coil Assembly"

by

R. Hertel

ITT Aerospace - Optical Division

Ft. Wayne, Indiana

Defense-Space Group
International Telephone and
Telegraph Corporation

Aerospace/Optical
Division

3700 E. Pontiac Street
Fort Wayne, Ind. 46803
(219) 743-7571

Project 64223

August 20, 1974

FINAL REPORT
IMPROVED F4012 IMAGE DISSECTOR COIL ASSEMBLY

Prepared for

ITT Gilfillan
Van Nuys, California

Prepared by

R. Hertel
ITT Aerospace-Optical Division
Fort Wayne, Indiana

1.0 INTRODUCTION

This report summarizes the results of the F4012 Vidissector(R) image dissector tube and coil improvement program from the viewpoint of the tube and coil fabrication. The originally proposed changes are listed below.

1) The mesh to photocathode spacing will be reduced. The F4012RP has the poorest aspect ratio (cathode diameter to spacing) of all the Vidissector image vidissectors. A decrease in spacing will reduce the distortions of the electric field at the edge of the photocathode. It is expected that this will improve off axis resolution and geometrical distortion.

2) The tube will be fabricated with new parts and tooling designed to reduce the amount of tilt between the photocathode and mesh and the amount of run out of the photocathode and mesh relative to the envelope.

   It is expected that this will allow better alignment of the focus coil and tube. This should reduce the variation of resolution over the photocathode area as well as making any residual resolution losses or geometrical distortions more rotationally symmetric about the center of the tube.

3) The tube will be built with a non-magnetic mesh mounting ring.

4) The deflection coil will be a scaled down version of the design used on the 2-1/4 inch diameter Vidissector image dissectors. These 2-1/4" yokes are the state of the art in Vidissector image dissector yokes. Linearity of 0.25% has been demonstrated on a standard F4052RP (2-1/4 inch) Vidissector image dissector.

5) The focus coil will be wound such that with a shield in place the field uniformity better approximates the required values.

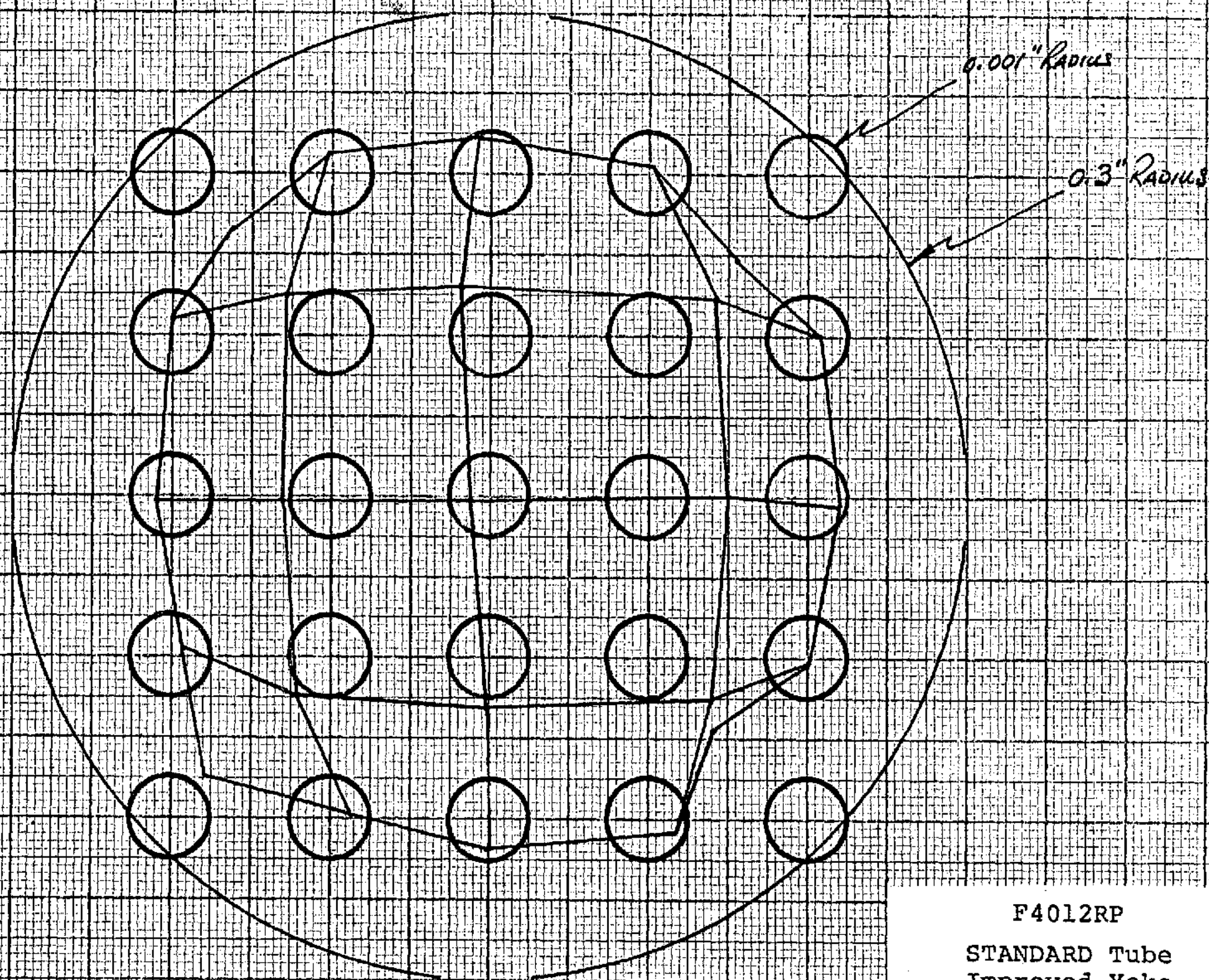
2.0 RESULTS

2.1 Tube Design

Two modified F4012RP(S20, 8S) Vidissectors were built by ITT-EOPD. These tubes incorporated several changes in the photocathode to mesh region which did reduce the distortions of the electrostatic acceleration field. These changes resulted in reduced static focus distortion for off axis image position when compared to a Standard F4012RP. See Figure 1. These changes were a reduction in the mesh to photocathode distance and a mechanical redesign of the faceplate/envelope interface. Such changes result in a much better approximation to a parallel plate accelerator. The mesh to cathode spacing was set at 0.075 ± .01 inches. An analysis indicates that spacings as close as 0.020" will not result in significant (i.e., < 1% modulation) mesh-in-focus phenomena. Other manufacturing constraints, however, limit this reduction to $\simeq$ 0.03 - .04 inches. The implication of a 0.03 - .04 inch spacing is that the acceleration electric field would be essentially planar across the photocathode diameter. Other steps were taken during the tube manufacture to insure

The view presented in the plot is how the tube would see a "perfect" grid; i.e., the view is distorted. The small circles are .001 inch radius. One can also think of the small circles as representing the aperture referred to the photocathode. For a linear model, the tube deflects beyond the correct coordinate at the corners.

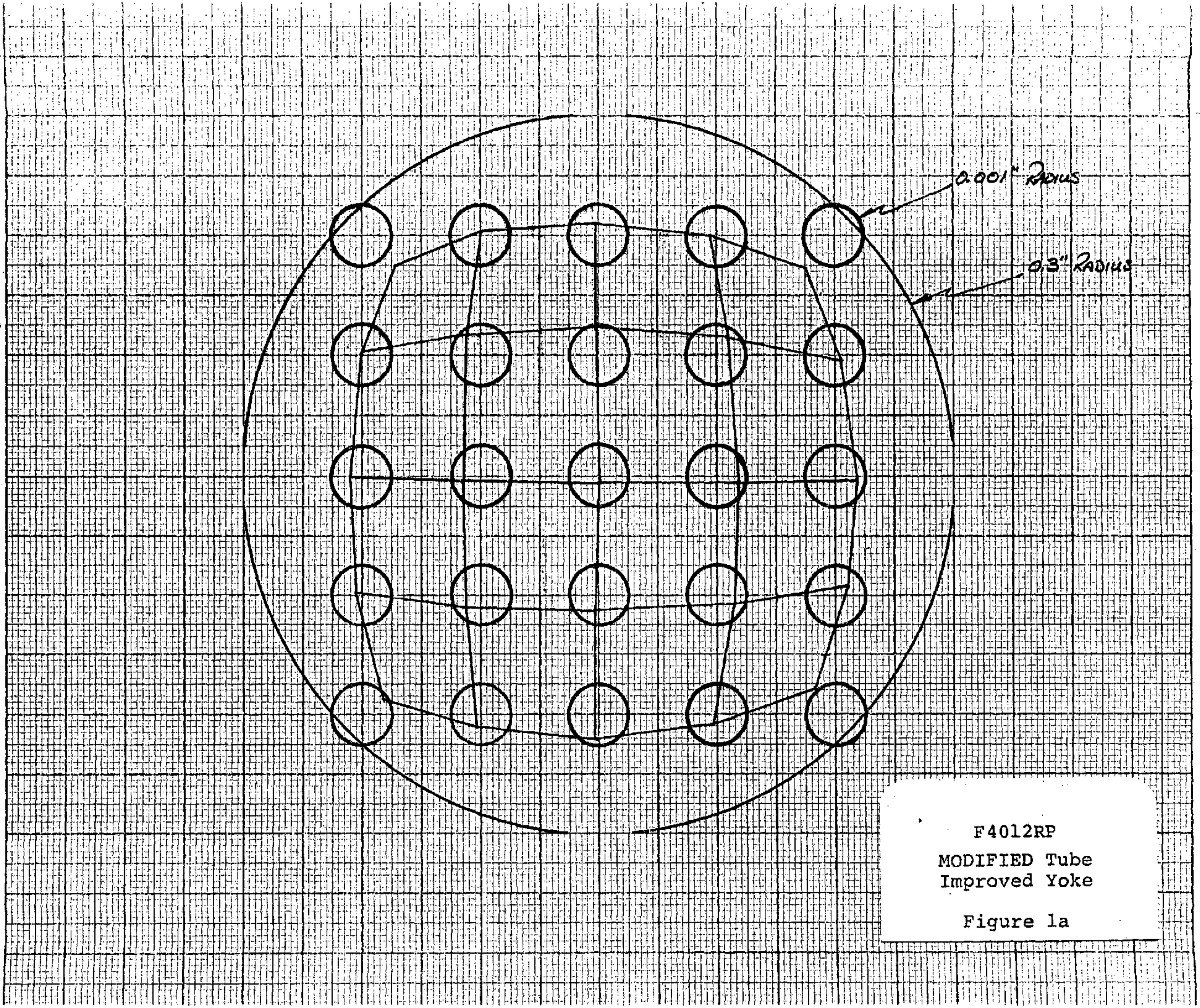
FIGURE 1



F4012RP

STANDARD Tube
Improved Yoke

Figure 1b



F4012RP
MODIFIED Tube
Improved Yoke

Figure 1a

the mesh to envelope and faceplate to envelope total indicated runout at ~ 0.4" radius were each less than 0.005 inches. This measure in part insures that the electron acceleration vector is parallel to the focus field vector. The consequence of a non-parallel condition is that the photoelectrons then see a greater variation in the focus and deflection fields because of their larger orbits. This results in focus and reflection errors.

The tubes were constructed with a minimum of magnetic materials. In the modified version of the F4012RP, the only magnetic materials are the mesh, the leads on the internal resistors and the stem pins. A standard F4012RP also has a magnetic mesh mount structure and aperture disc.

It has been recommended to ITT-EOPD Engineering that these modifications of the F4012RP be made part of the standard configuration with the exception of the aperture disc. (This disc is ~ 3/8" ϕ x .001" thick).

2.2 Coil Design

The yoke design was an extension of previous work done by ITT-A/OD for its line of Vidissector(R) cameras. The yoke is constructed on a glass-epoxy form having the turns captivated in specific slots along and around the tubular form. The entire assembly, deflection yoke, focus coil and shield were encapsulated. Attention was given to the uniformity of the magnetic field as well as the tube/coil relative position. It would appear that future improvements in this type of yoke for the F4012RP will be made to the extent that the tube and faceplate can be placed

deeper into the focus and deflection coils. (This sets a back focal length requirement for the lens).

Assembly S/N 1 was designed for 0.25" position. It, however, performed better at 0.38". Assembly S/N 2 was designed for 0.38". Table I summarizes the test data.

TABLE I - COMPARISON OF DEFLECTION ASSEMBLY DATA*

Parameter	S/N 1	S/N 2
Focus Coil		
Current	97mA	95mA
Resistance	133Ω	142Ω
Inductance	320mHy	330mHy
Inner Yoke		
Current	60.1mA/inch	60.1mA/inch
Resistance	139Ω	141Ω
Inductance	41.8mHy	41mHy
Outer Yoke		
Current	69.9mA/inch	65.9mA/inch
Resistance	147Ω	149Ω
Inductance	47.5mHy	47.5mHy
RMS Radial Geometrical Distortion (.4" x .4")	0.8×10^{-3} inch	0.7×10^{-3}
Peak Radial Geometrical Distortion (.4" x .4")	1.7×10^{-3} inch	1.5×10^{-3}
Skew +y cw to +x	-.3 Degrees	+.4 Degrees
Rise Distance	~10 - 15μm	~10 - 15μm
Weight	0.94 Kg	0.94 Kg
Length	5.50/5.45	
Diameter	2.275/2.235	

* Used Same F4012RP (S20, 8S) S/N 37404, 400 Volts .4" x .4" image format. Tube at 3/8".

A few comments on the data are appropriate. All the distortion patterns were very symmetrical (x-y symmetry). The tube coil combination over deflects (expansion) at corner positions. This is a convenient characteristic inasmuch as most deflection drivers and tracker servos will have a tendency toward signal compression. The observed skew on the finished assemblies was significantly greater than the encapsulated test setups. Prior to encapsulation skews of less than 0.1 degree were easily obtained. Further work on encapsulation techniques is perhaps desirable.

The rise distance improvement was not obtained as was expected. It is thought that the reason for this is the scattered/reflected light from the mesh. Another Study[1] by ITT-EOPD shows there is a significant amount of light returned from the mesh in a Vidissector. If this is the reason, a blackened mesh is a desirable addition to future tubes.

---

[1] Reduction of Veiling Glare in Electro-Optical Image Tubes. Technical Report AFAL-TR-73-136, May 1973, AFAL, WPAFB, OHIO 45433.

TEST PLAN

(including results of tests on Tube/Coil Assembly S/N 1)

of

Model F4012 RP

Tube/Coil Assemblies by

ITT Gilfillan

TEST PLAN

for

MODIFICATION, FABRICATION, TESTING AND DELIVERY

of

ITT MODEL F4012RP
TUBE/COIL ASSEMBLIES

for

NASA - GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NAS8-29918

ITT GILFILLAN
7821 Orion Avenue
Van Nuys, California

1.0 OBJECTIVE

The objective of this document is to outline the procedures to test the operation of the improved vidissector tube and coil assembly.

The tests are planned to measure parameters of the individual components as well as to evaluate the performance of the assembly as an integral unit. The results of the tests will be compared to design goals established by the specification (Exhibit A). The procedure objective is to prove that the assembly meets the specification requirements.

A test philosophy will be followed to use the procedure as an outline. If test results indicate, additional data shall be taken to determine the component parameters more completely.

2.0 TEST EQUIPMENT

2.1 Commercial Test Equipment

Oscilloscope, Tektronix
Type 454

Oscilloscope, Hewlett-Packard
Type 130C

Digital Voltmeter, Hewlett-Packard
Type 3440A
Plug-in Type 3440A

Gaussmeter, Radio Frequency Labs.
Model 750

Scales, Ohaus
Model 1119

Power Supply Twin, Power Design
Model TW 5005

Power Supply, Power Design
Model 5015A

Oscillator, Hewlett-Packard
Model 200CD

Electrometer, Keithley
Model 610A

Environmental Chamber

Micro Flat, Collins

X-Y Table, Fehlman

Instrument Stand, Davidson Optronics

Dial Indicators, Starrett
No. 565-517

Laser, Spectra Physics 126

Collimator, Spectra Physics
Model 336 (3.3u aperture)

Filter Holder

Filter No. 0.2, 0.5, 1.08, 2.0D

2.2 Special Test Equipment

Dark Room

Tube and Coil Fixture

Static Test Unit

Helmholtz Coil

Optics

3.0 TEST PROCEDURE - COIL ASSEMBLY

Coil Type ITTADD 8007846-1 S/N SN-1

3.1 Dimensions

Referring to Figure 1, check the physical dimensions of the coil assembly and record in the Table 1.

Figure 1

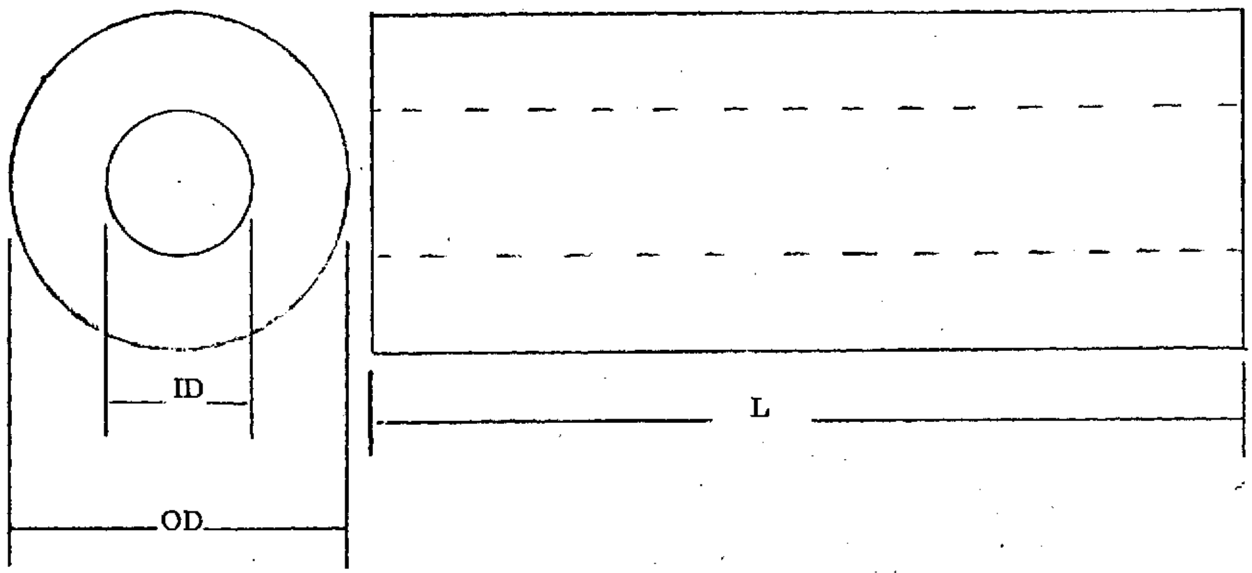


Table 1

Dimension	Goal Inches	Measure Inches
ID	1.140 ± 0.010	1.125
OD	2.25 Max	2.25
L	5.50	5.4687

3.2 Weight

Weigh the Tube and Coil Assembly, using the Model 1119 Ohaus balance and record weight.

Measured 920 grams Coil Assembly
71 grams Tube

3.3 Resistance and Inductance

3.3.1 Horizontal Deflection Coil

Connect the horizontal coil to the "unknown" terminals of the GR 1650 impedance bridge. Connect all shields to the terminal marked "low". Measure and record in Table II the resistance and inductance of the horizontal coil.

3.3.2 Vertical Deflection Coil

Connect the vertical deflection coil using the same instrument and terminals as explained in 3.3.1. Measure and record the resistance and inductance of the vertical deflection coil in Table II.

3.3.3 Focus Coil

Connect the focus coil using the same instrument and terminals as explained in 3.3.1. Measure and record the resistance and inductance in Table II.

3.4 Coil Self Resonant Frequency

3.4.1 Horizontal Deflection Coil

Connect the horizontal deflection coil in series with 10K resistor across the terminated output termin als of a test oscillator with the coil tied to the low side of the oscillator and the resistor to the high side of the oscillator. Tie all shields to ground. Using a Tektronix 454 oscilloscope sense the voltage the high side of the generator with Channel 1. Using Channel 2 tied to the coil-resistor junction, sense the voltage across the horizontal coil. Obtain sync directly from the high side of the test oscilloscope output to externally sync time base using AC, LF reject. Starting from a low frequency, find the first frequency at which the two channels are in phase after any out of phase condition as the test oscillator frequency is increased. Record the frequency indicated on the dial in Table II as the self resonant frequency of the horizontal coil.

3.4.2 Vertical Coil

Connect the vertical coil as explained in 3.4.1. Record the self resonant frequency of the vertical coils in Table II.

3.4.3 Focus Coil

Connect the focus coil as explained in 3.4.1. Record the self resonant frequency at the focus coil in Table II.

Table II

Coil	Resistance	Inductance	Self Resonant Frequency
RED/BLK Horozontal	139.3	41.5 MH	66KHZ
WHT/GRN Vertical	146.9	47.4 MH	57KHZ
Focus	136.2	316 MH	10.4KHZ

4.0 TEST PROCEDURE - VIDISSECTOR

Tube Type F4012 RP

Tube S/N 037403

4.1 Attach pertinent tube data supplied by ITT A/OD

4.1.1 Spectral Response

4.1.2 Uniformity

5.0 TEST PROCEDURE - SENSOR ASSEMBLY

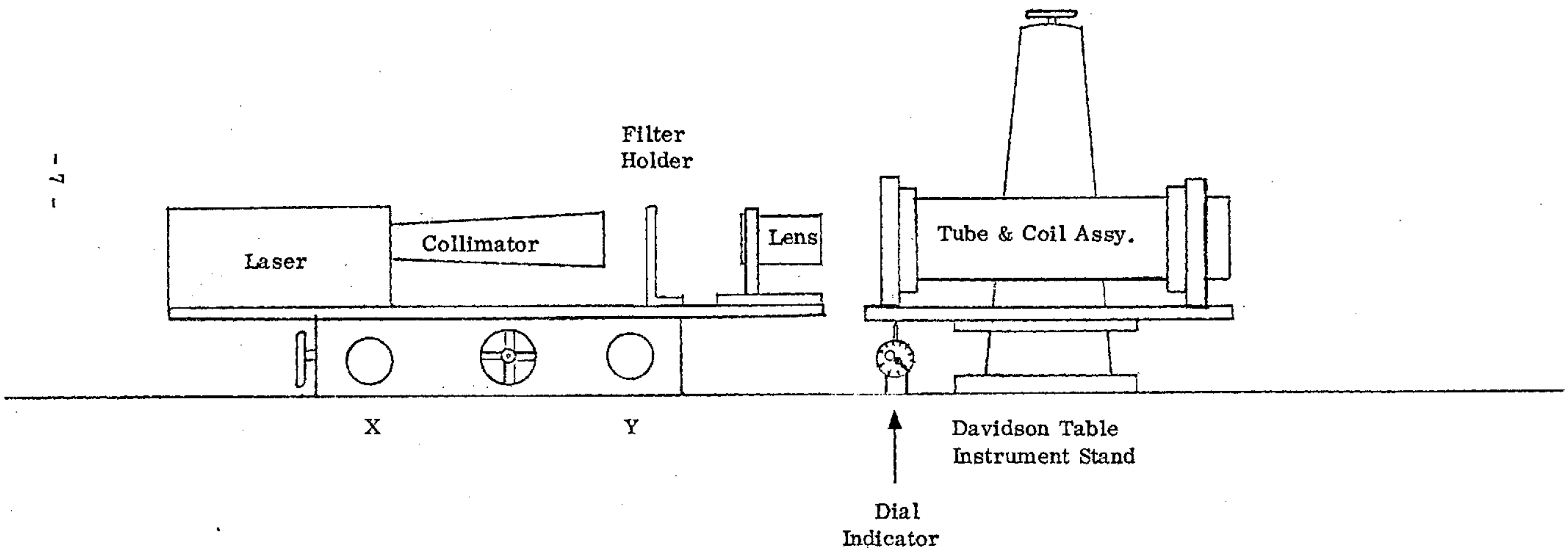
5.1 Initial Conditions

Mount the tube and coil assembly on the two axis table (see Figure 2). Insert an N. D. 2.0 Wratten filter in holder in front of laser collimator. Turn laser on. Adjust motion table (X and Y) manual controls to position spot image in approximate center of photocathode and for best focus on photocathode visually. Make connection from the static test unit to the vidisector tube, focus coil, vertical deflection coil, and horizontal deflection coil as shown in Figure 3. The tube voltage divider is shown in Figure 4. Turn on static test unit and allow 30 minutes warm up. Set the scan mode switch to "acquisition". Adjust multiplier section voltage to -1198 volts. Measure photocathode voltage 400 volts. Adjust focus coil current to 97 ma.

Observe video amplifier waveform with oscilloscope and adjust focus current, optical focus, and motion table to obtain best electrical and optical focus of spot image and position of image in center of acquisition field. Again record focus coil current 94.5 ma.

Turn scan mode switch to "track". Confirm that closed loop tracking has been established in both axis by moving the light spot off axis and observing an increase or decrease in error signals. Position and readjust motion table control to null the norizontal and vertical error signals with digital voltmeter.

Figure 2



Micro Flat

STATIC TEST UNIT

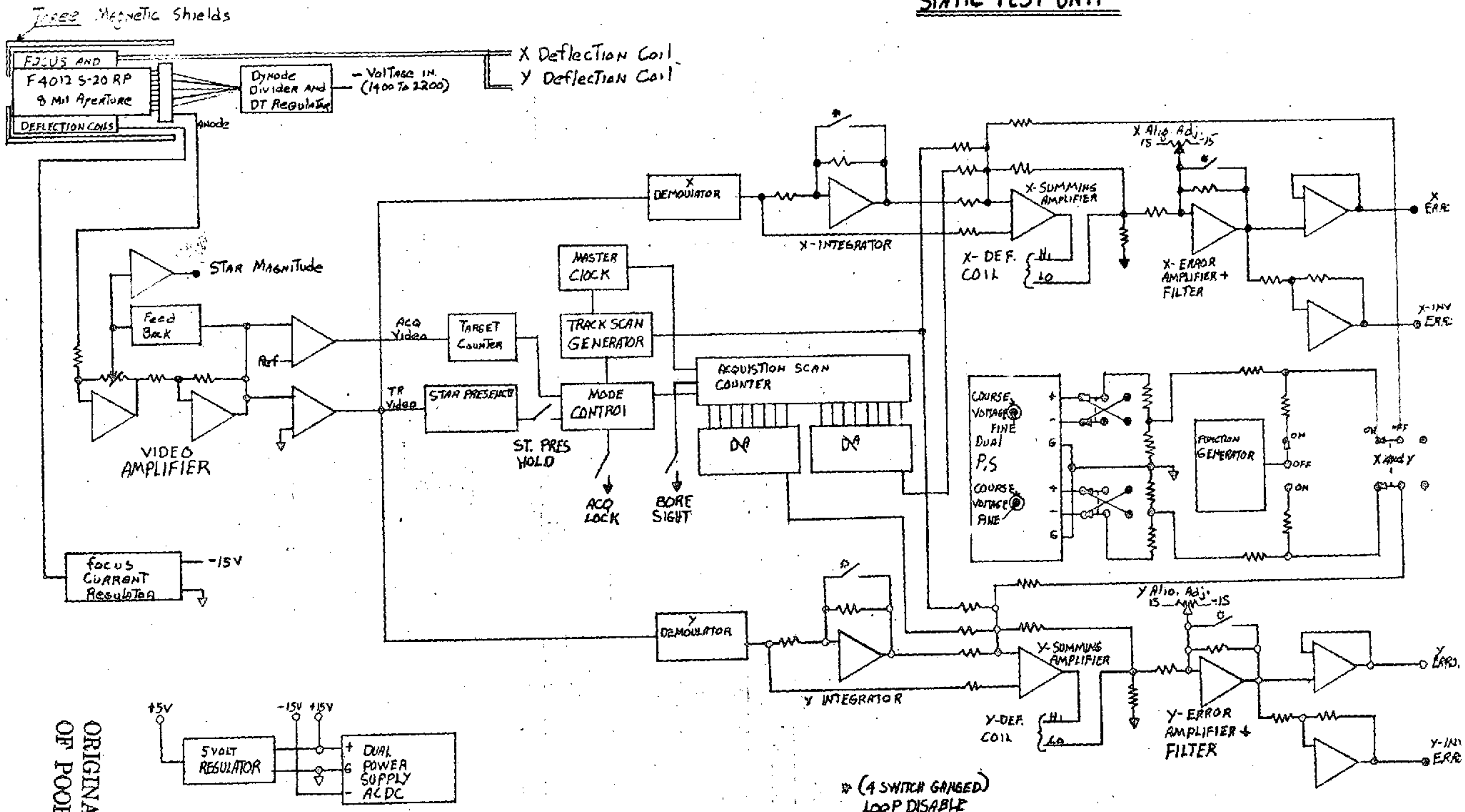


Figure 3

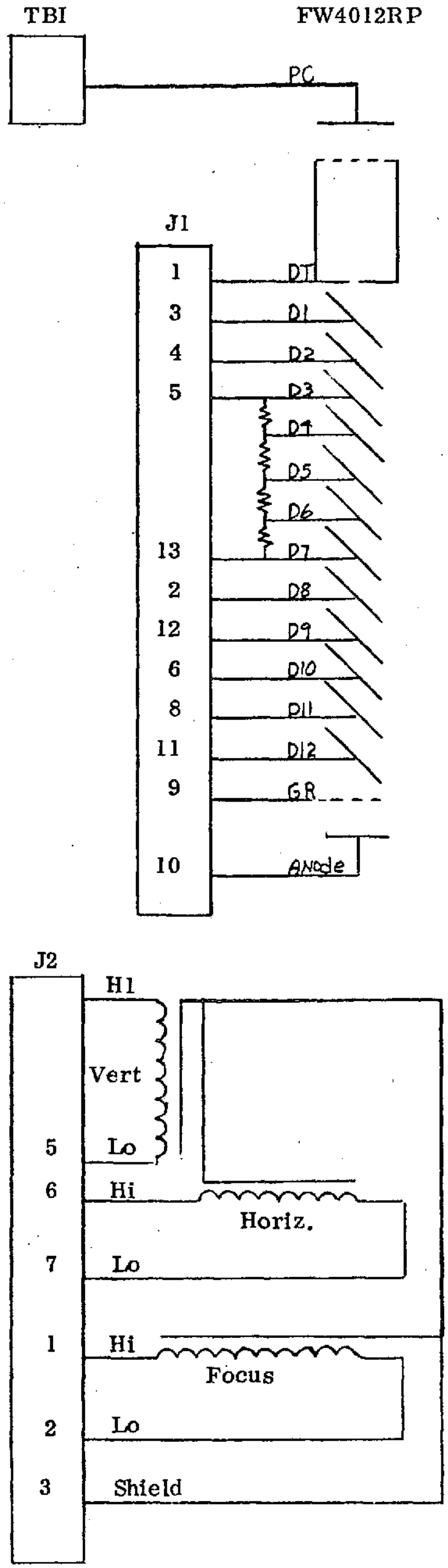
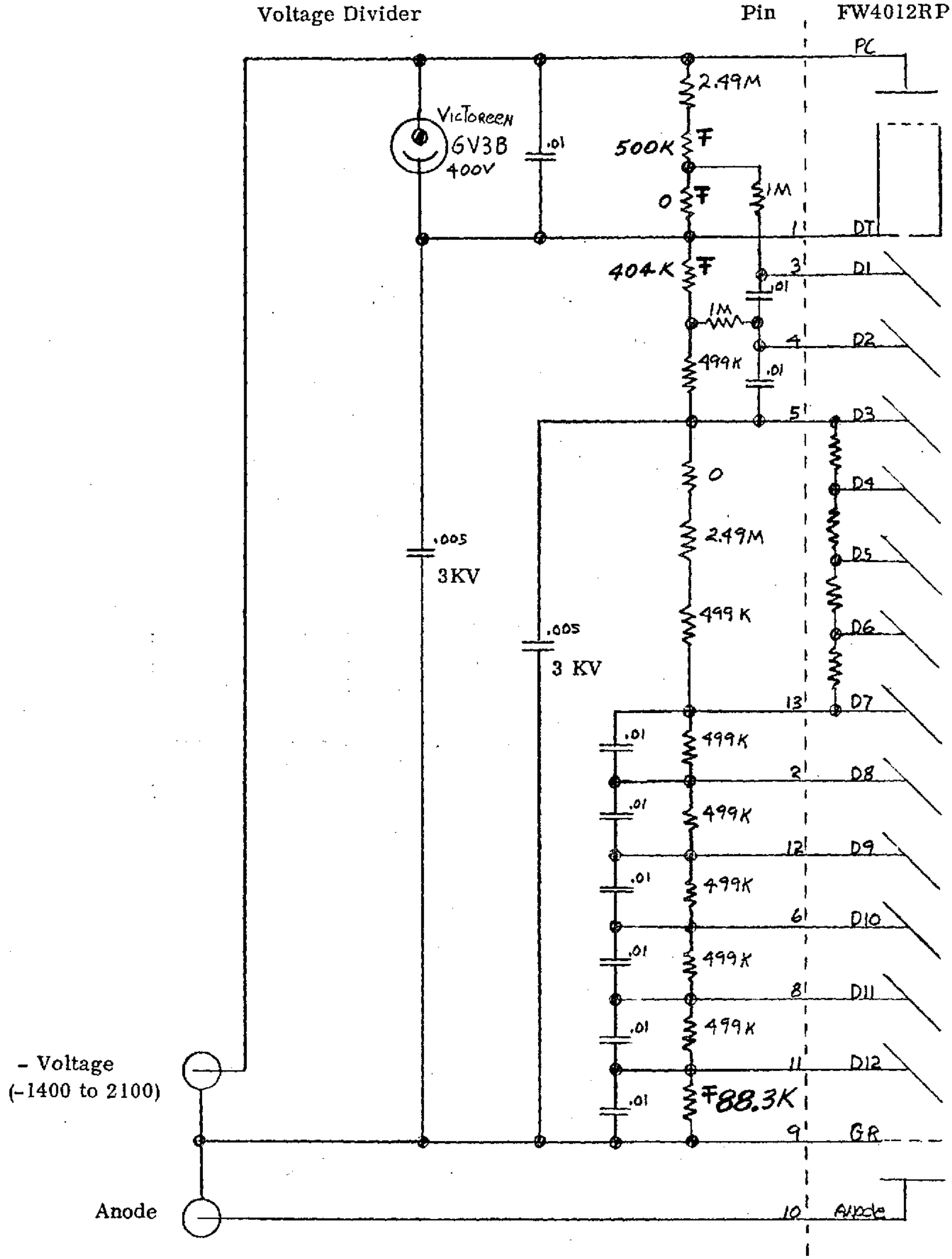

TBI
FW4012RP
PC
J1
1
3
4
5
13
2
12
6
8
11
9
10
DT
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
GR
ANode
J2
H1
Vert
5
Lo
6
Hi
Horiz.
7
Lo
1
Hi
Focus
2
Lo
3
Shield

Figure 4



NOTE: Unless otherwise specified

1. All capacitance values in microfarads
2. All resistance in ohms $\frac{1}{4}$W, 1%

5.1.1 Dark Current

Connect electrometer to anode at vidissector and with vidissector in total darkness, measure dark current and record 6.6×10^{-10} amps.

5.2 Test Procedure - Static Grid Pattern Deflection Data

With the deflection coil axis aligned to the table axis and with equipment in closed loop operation, move the point image on the photocathode in a regular .050" rectangular grid pattern over the photocathode surface using the motion table controls. Measure and record the horizontal and vertical static deflection ~~current~~ voltage at each of the grid points as listed in Table III A, B, C and D. *

* See note on following page.

5.3 Linearity

5.3.1 Horizontal Axis Linearity

Calculate least mean squares best straight line using horizontal deflection data from data points on the horizontal axis from Table III and using the following equations:

$$H = bx$$

where
H = Horizontal deflection current
X = Horizontal displacement in inches
b = Horizontal best straight line slope

$$b = \frac{N\,(Xi\,Hi) - (Xi)\ (Hi)}{N\,(\,(Xi)^2) - (Xi)^2}$$

Use 13 data points (n-13) on the horizontal axis from .300 inch on one side to .300 inch on the other side. Record the values of b below:

b = 21.326 volts/inch

Calculate deviations from the best straight line at each data point in inches and as a percentage of photocathode diameter (.700 inches) and record in Table IV. Record the greatest deviation from the best straight line of the 13 points calculated in Table IV.

NOTE: Throughout the test procedure measurements of deflection are made and tabulated in volts. The static test tracker provides deflection coil pickoff resistors through which the deflection current flows. The readings are the voltage across these pickoff resistors which for both channels are 332 ohms. The deflection current can be calculated by dividing the tabulated readings by 332.

TABLE III A

5.2 Static Grid Pattern Deflection Data

Inches from Center of Photocathode		Horizontal 0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350
Vertical 0.000	Horiz.	0.000	1.072	2.124	3.193	4.257	5.335	6.424	0.3371 7.229
	Vert.	0.000	0.001	0.001	-0.001	-0.006	-0.017	-0.026	-0.036
0.050	Horiz.	0.014	1.082	2.134	3.209	4.269	5.354	6.434	0.3375 7.256
	Vert.	0.932	0.935	0.934	0.933	0.931	0.926	0.922	0.923
0.100	Horiz.	0.029	1.102	2.164	3.239	4.310	5.396	6.481	0.3309 7.152
	Vert.	1.864	1.866	1.867	1.867	1.869	1.869	1.869	1.876
0.150	Horiz.	0.046	1.112	2.180	3.260	4.331	5.425	6.513	0.3160 6.853
	Vert.	2.802	2.805	2.808	2.810	2.815	2.818	2.820	2.822
0.200	Horiz.	0.061	1.139	2.203	3.283	4.361	5.456	0.2528 6.370	
	Vert.	3.745	3.747	3.751	3.757	3.769	3.773	3.772	
0.250	Horiz.	0.077	1.160	2.224	3.313	4.385	5.485	0.2578 5.648	
	Vert.	4.692	4.696	4.701	4.710	4.721	4.736	4.734	
0.300	Horiz.	0.093	1.179	2.249	3.340	4.420	0.2427 4.577		
	Vert.	5.644	5.648	5.654	5.669	5.674	5.670		
0.350	Horiz.	0.106	1.197	2.262	0.1229 2.765				
	Vert.	6.613	6.618	6.623	6.619				

0.3744 H 0.115

V 7.117

NOTE: Horizontal and Vertical Deflection ~~Current~~ in ~~Milliampers~~ Volts

Quadrant as seen facing the Photocathode

TABLE III B

5.2 Static Grid Pattern Deflection Data

Inches from Center of Photocathode		Horizontal 0.000	-0.050	-0.100	-0.150	-0.200	-0.250	-0.300	-0.350
Vertical	Horiz.	0.000	-1.057	-2.123	-3.179	-4.255	-5.324	-6.407	-0.3495 -7.484
0.000	Vert.	0.000	-0.003	-0.006	-0.008	-0.008	-0.008	-0.008	-0.007
	Horiz.	0.014	-1.044	-2.107	-3.162	-4.231	-5.297	-6.383	-0.3515 -7.492
0.050	Vert.	0.932	0.928	0.925	0.922	0.925	0.931	0.936	0.944
	Horiz.	0.029	-1.037	-2.107	-3.170	-4.246	-5.319	-6.414	-0.3454 -7.397
0.100	Vert.	1.864	1.862	1.860	1.859	1.858	1.856	1.857	1.877
	Horiz.	0.046	-1.017	-2.095	-3.152	-4.240	-5.315	-6.408	-0.3322 -7.104
0.150	Vert.	2.802	2.802	2.802	2.802	2.804	2.806	2.809	2.814
	Horiz.	0.061	-1.007	-2.086	-3.151	-4.236	-5.311	-6.411	-0.3097 -6.616
0.200	Vert.	3.745	3.743	3.745	3.749	3.755	3.762	3.783	3.784
	Horiz.	0.077	-0.993	-2.077	-3.145	-4.234	-5.315	-0.2772 -5.891	
0.250	Vert.	4.692	4.691	4.695	4.702	4.714	4.735	4.743	
	Horiz.	0.093	-0.983	-2.071	-3.145	-4.241	-0.2282 -4.846		
0.300	Vert.	5.644	5.644	5.651	5.663	5.673	5.663		
	Horiz.	0.106	-0.976	-2.064	-0.1455 -3.035				
0.350	Vert.	6.613	6.610	6.619	6.622				
0.3744	H	0.115							
	V	7.117							

NOTE: Horizontal and Vertical Deflection ~~Current~~ in Volts ~~Milliampere~~

Quadrant as seen facing the Photocathode

TABLE III C

5.2 Static Grid Pattern Deflection Data

Inches from Center of Photocathode		Horizontal 0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350
Vertical 0.000	Horiz.	0.000	1.072	2.124	3.190	4.257	5.337	6.424	0.3372 7.225
	Vert.	0.000	0.001	0.000	-0.002	-0.006	-0.017	-0.026	-0.037
-0.050	Horiz.	-0.015	1.054	2.114	3.182	4.248	5.329	6.411	0.3298 7.056
	Vert.	-0.934	-0.934	-0.939	-0.940	-0.947	-0.956	-0.970	-0.978
-0.100	Horiz.	-0.030	1.041	2.097	3.171	4.240	5.326	6.410	0.3140 6.707
	Vert.	-1.865	-1.873	-1.879	-1.876	-1.876	-1.899	-1.914	-1.915
-0.150	Horiz.	-0.046	1.025	2.087	3.159	4.232	5.325	0.2880 6.140	
	Vert.	-2.802	-2.808	-2.816	-2.818	-2.830	-2.848	-2.858	
-0.200	Horiz.	-0.062	1.015	2.081	3.161	4.235	0.2497 5.310		
	Vert.	-3.741	-3.749	-3.758	-3.762	-3.779	-3.797		
-0.250	Horiz.	-0.077	1.005	2.077	3.156	0.1926 4.073			
	Vert.	-4.684	-4.689	-4.701	-4.709	-4.719			
-0.300	Horiz.	-0.090	0.997	0.0828 1.700					
	Vert.	-5.641	-5.648	-5.652					
-0.350	Horiz.	-0.3095 -0.092							
	Vert.	-5.841							

NOTE: Horizontal and Vertical Deflection ~~Current~~ Volts in ~~Milliampers~~

Quadrant as seen facing the Photocathode

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TABLE III D

5.2 Static Grid Pattern Deflection Data

Inches from Center of Photocathode		Horizontal -0.000	-0.050	-0.100	-0.150	-0.200	-0.250	-0.300	-0.350
Vertical 0.000	Horiz.	0.000	-1.056	-2.124	-3.178	-4.254	-5.324	-6.404	-0.3495 -7.486
	Vert.	0.000	-0.003	-0.007	-0.007	-0.008	-0.008	-0.008	-0.007
-0.050	Horiz.	-0.015	-1.068	-2.137	-3.201	-4.223	-5.338	-6.434	-0.3404 -7.302
	Vert.	-0.934	-0.935	-0.937	-0.940	-0.944	-0.947	-0.951	-0.953
-0.100	Horiz.	-0.030	-1.091	-2.161	-3.214	-4.295	-5.362	-6.453	-0.3230 -6.948
	Vert.	-1.865	-1.867	-1.870	-1.876	-1.881	-1.889	-1.897	-1.897
-0.150	Horiz.	-0.046	-1.110	-2.179	-3.241	-4.312	-5.388	-0.2960 -6.395	
	Vert.	-2.802	-2.804	-2.809	-2.817	-2.826	-2.837	-2.841	
-0.200	Horiz.	-0.062	-1.130	-2.201	-3.263	-4.350	-5.421	-0.2574 -5.580	
	Vert.	-3.741	-3.743	-3.750	-3.759	-3.773	-3.789	-3.788	
-0.250	Horiz.	-0.077	-1.143	-2.224	-3.297	-4.379	-0.1490 -4.364		
	Vert.	-4.684	-4.686	-4.695	-4.707	-4.718	-4.720		
-0.300	Horiz.	-0.090	-1.171	-0.0883 -2.004					
	Vert.	-5.641	-5.645	-5.698					
-0.350	Horiz.	-0.3095 -0.092							
	Vert.	-5.841							

NOTE: Horizontal and Vertical Deflection ~~Current~~ in ~~Milliampere~~ Volts

Quadrant as seen facing the Photocathode

TABLE IV

Horizontal Linearity Deviation

Horiz. Axis Position Inches	Deviation of Actual from BSL Inches	Percentage Deviation (% of 0.6")
+ 0.300	+0.0012	0.2%
+ 0.250	+0.0002	0.03%
+ 0.200	-0.0004	0.06%
+ 0.150	-0.0003	0.05%
+0.100	-0.0004	0.06%
+0.050	+0.0003	0.05%
0.000	-0-	0
-0.050	-0.0004	0.06%
-0.100	-0.0004	0.06%
-0.150	-0.0009	0.15%
-0.200	-0.0004	0.06%
-0.250	-0.0003	0.05%
-0.300	+0.0004	0.06

Horizontal Deviation Greatest Percentage 0.2 %

TABLE V

5.3.2 Vertical Axis Linearity

Vertical Axis Position Inches	Deviation of Actual from BSL Inches	Percentage Deviation
+0.300	+ 0.0009	0.15 %
+0.250	+ 0.0001	0.03 %
+0.200	- 0.0003	0.05 %
+0.150	- 0.0006	0.1 %
+0.100	- 0.0006	0.1 %
+0.050	- 0.0003	0.05 %
0.000	-0-	-0-
-0.050	- 0.0001	0.03 %
-0.100	- 0.0005	0.09 %
-0.150	- 0.0006	0.1 %
-0.200	- 0.0005	0.09 %
-0.250	- 0.0002	0.03 %
-0.300	+ 0.0007	0.13 %

Vertical Deviation Greatest Percentage 0.15 %

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5.3.2 Vertical Axis Linearity

Calculate the least mean squares best straight line using vertical deflection data from data points on the vertical axis from Table III and using the following equation:

$$V = dy$$

where V = Vertical deflection current in ma.

y = Vertical displacement in inches

d = Vertical best straight line slope

$$d = \frac{N(Y_i V_i) - (Y_i V_i)}{N(Y_i)^2 - (Y_i)^2}$$

Use 13 data points (n-13) on the vertical axis from .300 inch on one side to .300 inch on the other side. Record the values of d below:

d = 18.754 volts/inch

Calculate the deviations from the best straight line at each data point in inches and as a percentage of the photocathode diameter (.700 inches) and record in Table V. Record the greatest deviation from the best straight of the 13 points calculated in Table V.

5.4 Deflection Sensitivity

5.4.1 Horizontal Deflection Sensitivity

Record the value of b as calculated in 5.3.1 below as the horizontal deflection sensitivity.

64.235 ma/inch

5.4.2 Vertical Deflection Sensitivity

Record the value of c as calculated in 5.3.2 below as the vertical deflection sensitivity.

56.488 ma/inch

5.5 Orthogonality

5.5.1 Horizontal Axis

Using the data from the four on-axis .150 inch data points from Table III calculate the equivalent displacement in inches that each point lies off axis. Calculate the angle between a line drawn through the two horizontal .150 inch points and the horizontal axis and tabulate below. Use the convention of counter-clockwise rotation as positive angle.

Deviation of horizontal axis -0.06 $^{\circ}$

5.5.2 Vertical Axis

Calculate the angle between a line drawn through the two vertical .150 inch point and the vertical axis and tabulate below.

Deviation of vertical axis -0.82 $^{\circ}$

5.5.3 Coil Orthogonality

Calculate the difference between the vertical deviation and the horizontal deviation and add 90° to obtain orthogonality. Record below.

Orthogonality 89.24 $^{\circ}$

5.6 Geometric Error Plot

The geometric error plot is obtained in the following manner by assuming nominal horizontal and vertical deflection sensitivities in 5.4, calculate ideal deflection current at each .050 inch data point out to .350. Calculate the deviation in horizontal and vertical deflection current at each data point in Table III from the ideal value calculated above. Then recalculate horizontal and vertical deviation as percentage of ideal full scale deflection current. Plot the deviations in inches on a graph. Expand the scale at each measured grid point to emphasize the map distortions.

An initial plot, Figure 5-6A, was made of the data from Table III A- III D. The procedure to generate the plot was:

1. Select a nominal gradient from all horizontal and vertical readings.
2. From the nominal gradients, the predicted readings at each is calculated.
3. The difference between the predicted readings and actual measurements is tabulated.
4. The differences are plotted on a graph with the scale expanded at the measurement points so that distortions are accentuated.

Conclusions from the initial plot are:

1. The non-orthogonality dominates the error contribution of an absolute position accuracy figure. The source of the non-orthogonality could have been instrumentation error since it was not evident on the original data taken by ITT A/OD.
2. A decrease to both selected gradients would result in a better fit of the actual to predicted data.
3. Actual data in the second quadrant ($-.300 \leq H \leq -.050$; $.050 \leq V \leq .100$) is somewhat distorted with respect to the other data.

An electronics compensation is proposed to correct the non-orthogonality displayed in the initial data. This is effected by merely coupling a percentage of one coil's drive to the opposite coil. Application of this electronic cross-coupling to our deflection coil would translate the measured H values an amount proportional to their distance from the Y = 0 line.

The effect of the electronic correction can be ascertained by applying the translation to the data. The percentage of electronic cross-coupling is chosen to translate the H values 0.015 volts/0.050 inches (V dimension). 0.050 inches is nominally .94 volts at the Y output. The second error characteristic, shown in Figure 5-6B, incorporates the non-orthogonality correction and a new gradient estimate.

It is noted that the optimum gradient used is slightly different than that calculated from the on-axis data in Section 5.3. The map gradient should be used since it considers data from the entire 0.6" diameter field. The deflection sensitivities are:

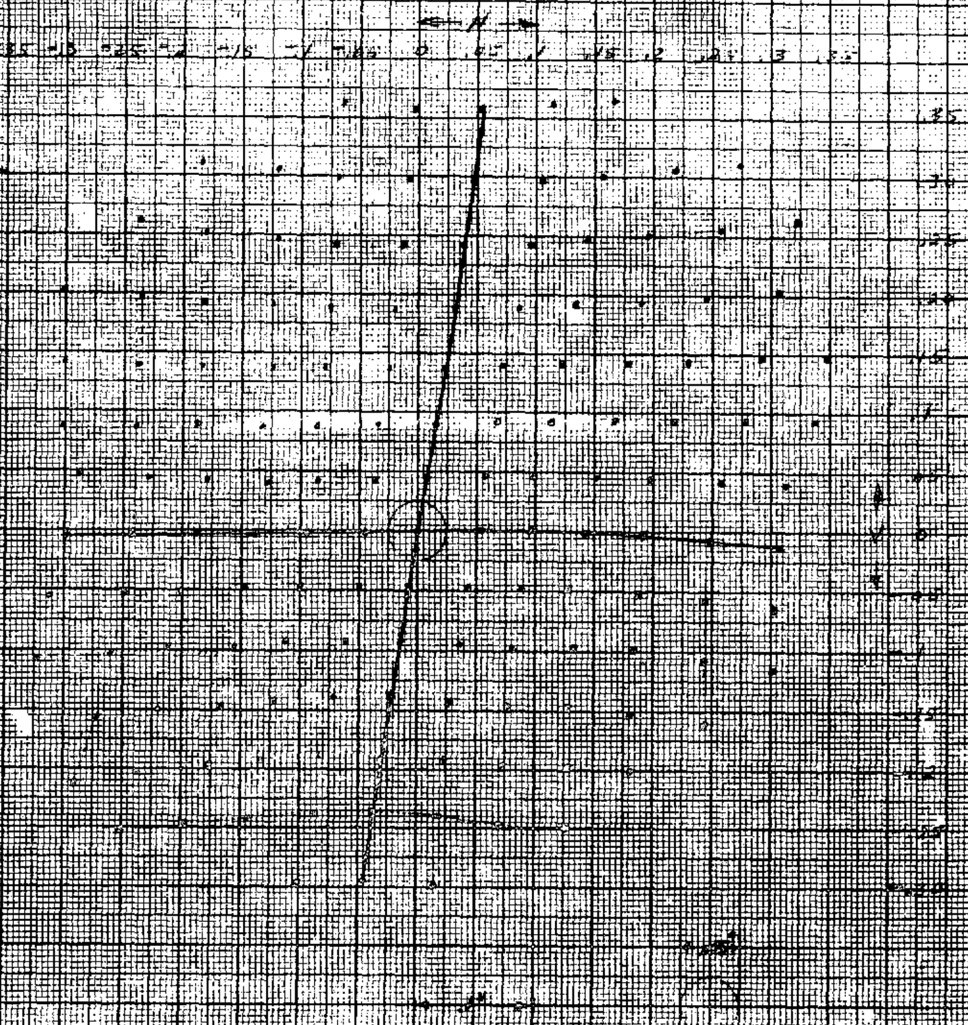
Horizontal 64.337 ma/inch Vertical 56.747 ma/inch

Inside a 0.3 inch radius the mean radial error using 121 data points is approximately 0.00075 inches.

FIG. 5-6A INITIAL PLOT

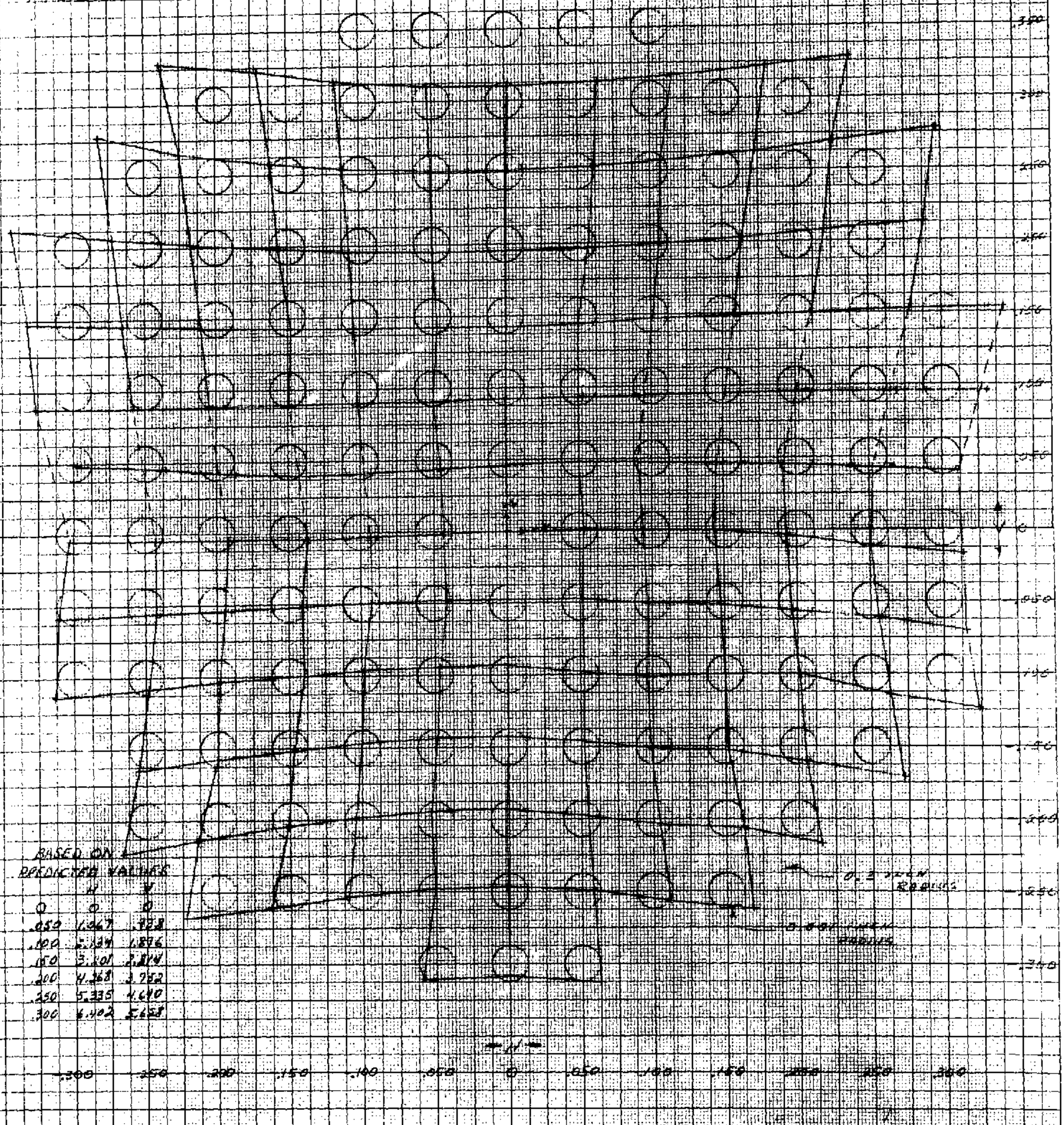
BASED ON INITIAL PREDICTED VALUES

	H	V
0	0	0
.050	1.068	.942
.100	2.136	1.884
.150	3.204	2.826
.200	4.272	3.768
.250	5.340	4.710
.300	6.408	5.652
.350	7.476	6.594



K+E 10 X 10 TO ½ INCH 47 1323
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

FIG 5-6B FINAL PLOT



BASED ON
PREDICTED VALUES

	H	V
0	0	0
.050	1.067	.938
.100	2.134	1.876
.150	3.201	2.814
.200	4.268	3.752
.250	5.335	4.690
.300	6.402	5.628

5.7 Resolution

Turn the test equipment power off. Place equipment in an open loop horizontal line scan mode. Mechanically move image to the first data point listed in Table VI using the table controls. Optimize electrical focus for each measured point. Adjust the D.C. offset current in the vertical axis so that the electrical scan is centered on the image position on the photocathode. This is effected by setting the current to the difference between value when the scan line barely intersects the image at either extremes. Obtain and X, Y plot of the video at the data point. Measure the 10% and 90% point of the video and calculate the rise distance in microns. Record in Table VI.

$$Rd\ (u) = \frac{Rd\ (inch)}{u}$$

$$Rd\ (inch) = \frac{Ic}{Def.\ Sen./In}$$

$$Ic = |\ Ic_1 - Ic_2\ |$$

$$Ic_1 = Ic\ @\ I_T = .91p$$

$$Ic_2 = Ic\ @\ I_T = .Ip$$

Rd = Rise Distance

u = 3.937×10^{-5}

I_T = Target Current

I_p = Peak I_T

I_C = Def. Coil Current

5.7.1 Tube Uniformity

Measure the 100% point of the video X-Y plot and tabulate in Table VI. Turn the test equipment power switch off and place equipment in vertical line scan mode. Repeat above procedure for each data point of Table VI.

NOTE: The source used throughout these tests was a Spectra-Physics Model #126 He-Ne laser outfitted with a Model #336 collimator. The collimator used a 3.3 micron aperture at the focal plane of a 200 mm focal length lens. The optics for the image dissector was a Schneider f/1.2, 50 mm focal length lens.

Prior to resolution tests, the image size through the Schenider lens was measured with a microscope. The image diameter at the third diffraction ring was 14 microns. Although appreciably smaller than the image dissector aperture, this was only slightly less than the measured rise distance. A sample illustration of the rise distance measurement is given on the following page. The 10% and 90% points are taken from a straight line drawn through the transition line. These are the values tabulated in Table VI. This manner of determining rise distance will be valid if the optical image size is smaller than the image dissector rise distance. For most of the measurements, the above condition is true and a good straight line estimate can be drawn.

The horizontal and vertical rise distances were measured for nine positions shown in the following sketch

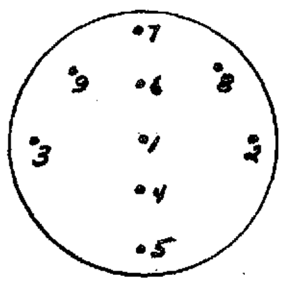


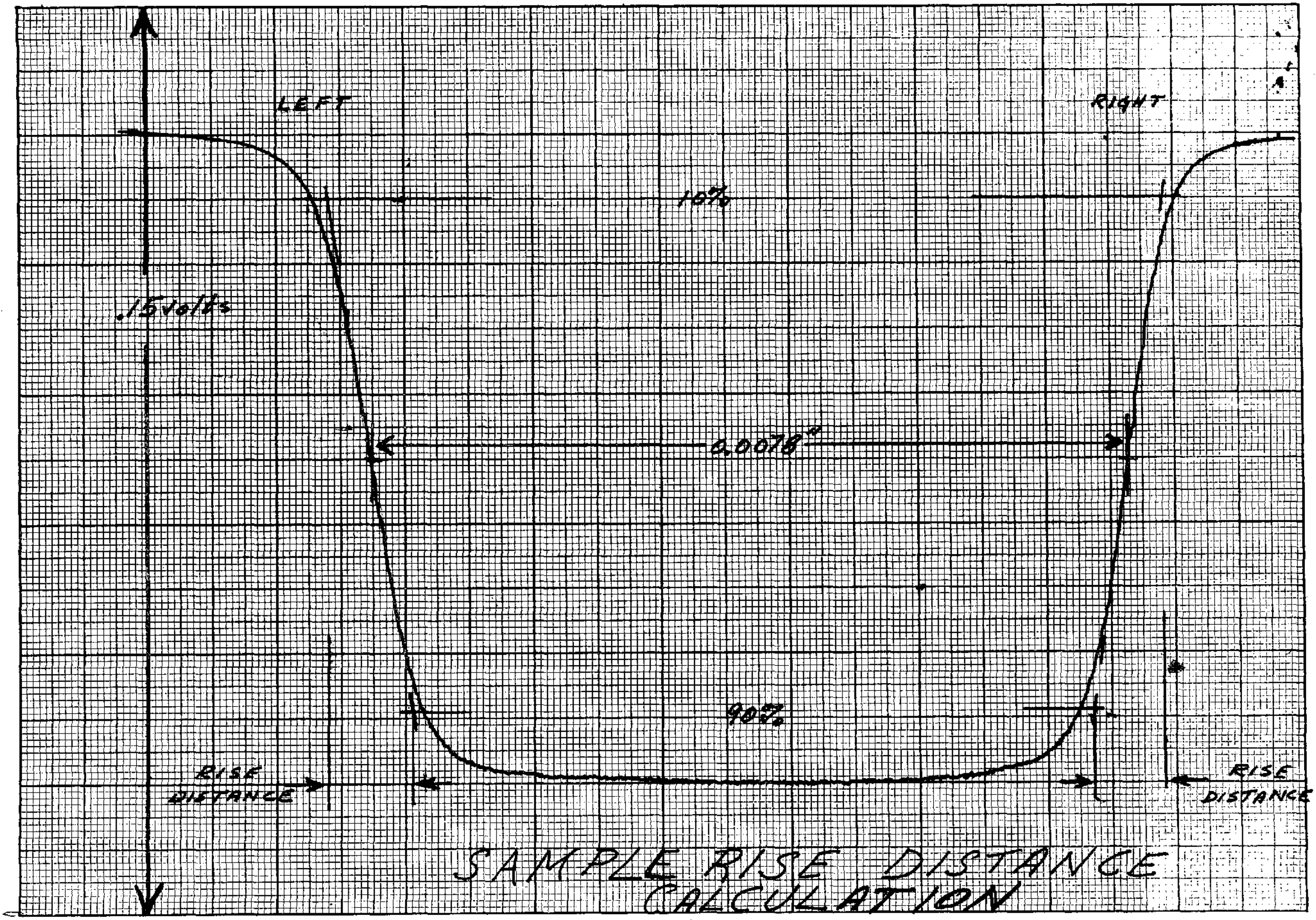
Table VI

5.7 Resolution

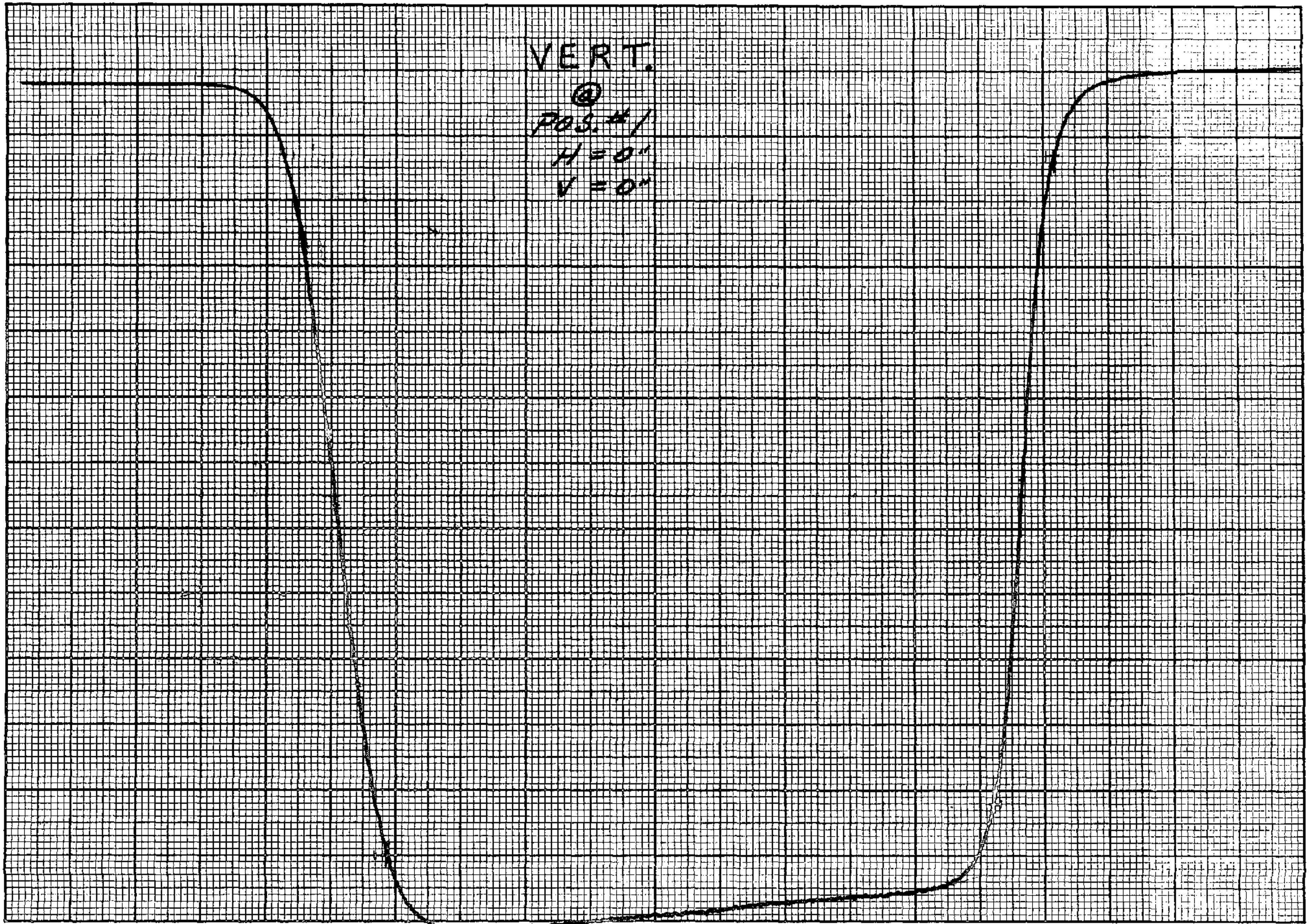
5.7.1 Tube Uniformity

Focus Current (M.A.)	Inches from Center of Photocathode		Rise Distance Horizontal		Rise Distance Vertical		Video Amplitude 100% Pt MV	Computed Resolution	
	Horiz	Vert	Left μ	Right μ	Left μ	Right μ		H	V
94.3	0	0	18.59	14.28	23.41	13.57	.137		
93.2	0.30	0	25.90	19.93	21.15	17.01	.107		
93.0	-0.30	0	21.58	21.58	22.28	18.12	.110		
93.9	0	-0.15	18.93	12.29	19.64	14.73	.133		
92.8	0	-0.30	18.27	13.95	22.28	16.99	.109		
94.2	0	0.15	21.26	14.61	18.89	14.73	.137		
93.1	0	0.30	14.95	12.96	17.75	15.87	.093		
93.0	0.2125	0.2125	15.28	11.95	18.51	14.73	.096		
93.1	-0.2125	0.2125	22.25	22.25	22.66	20.01	.096		

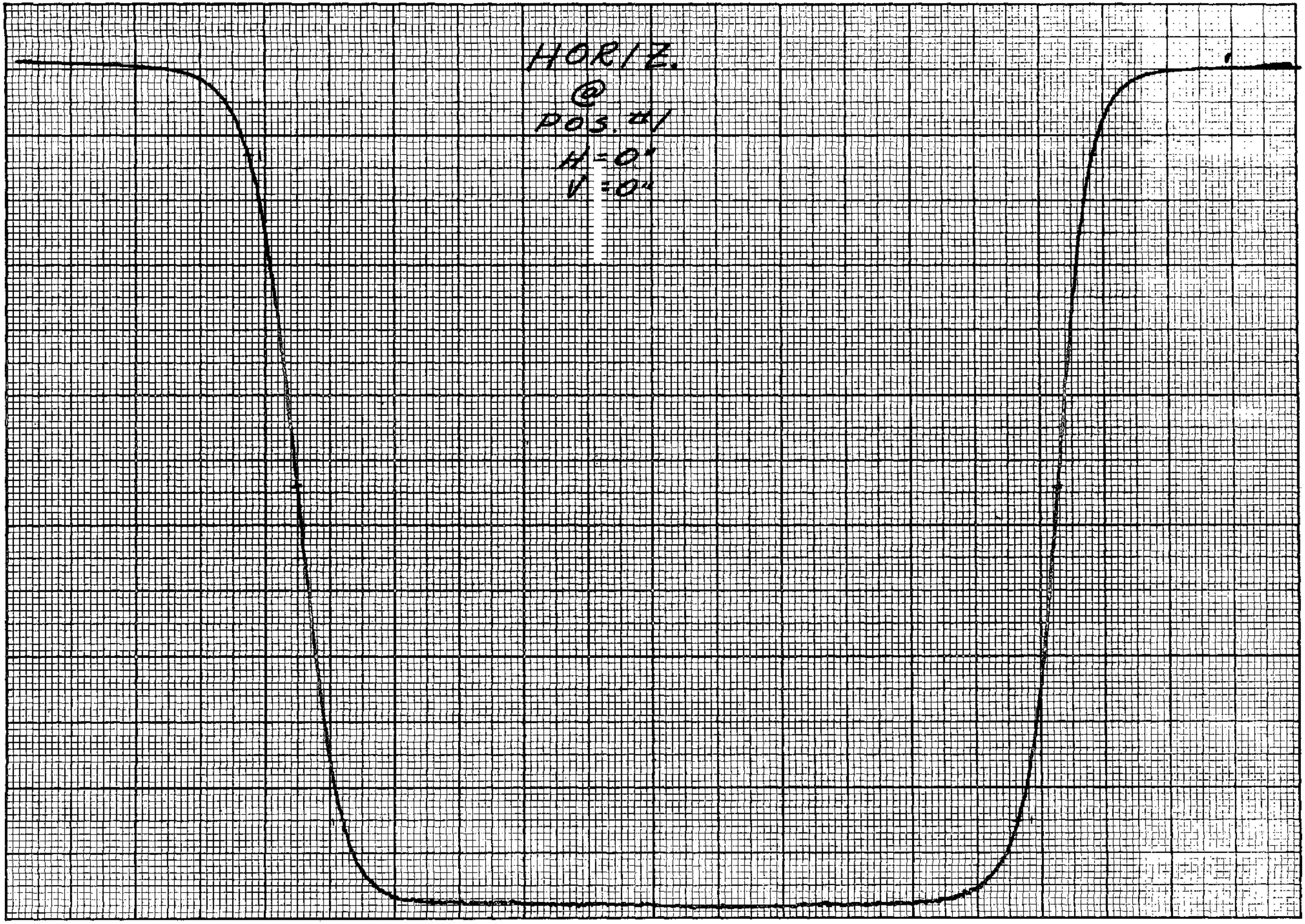
Resolution: The goal over 0.6 inch diameter is 4μ near the center and 6μ at the edge. The tube resolution shall be computed between the 10% and 90% point of the tube rise distance when taking into account the optical image shape.

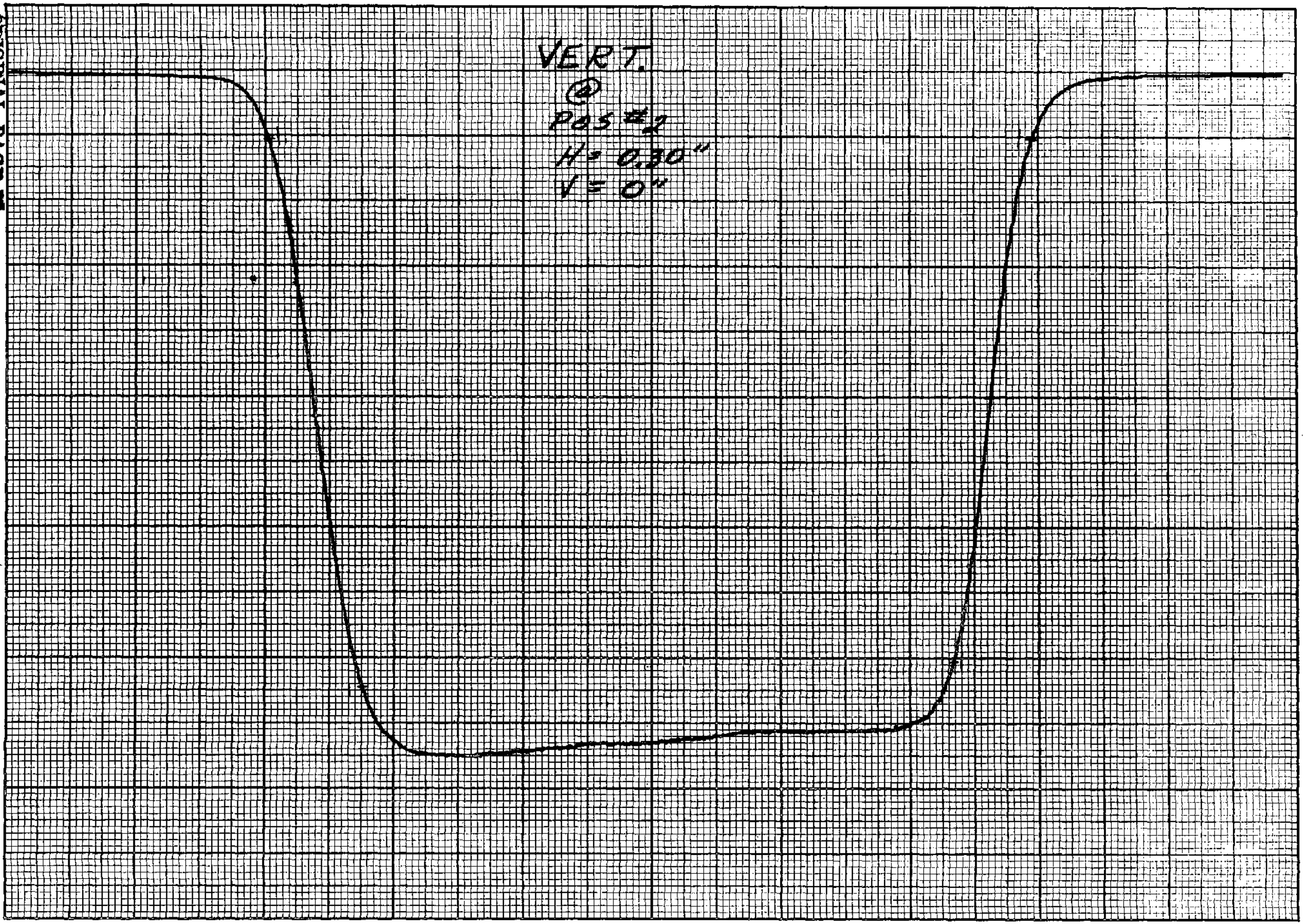

LEFT
RIGHT
10%
.15volts
0.0078"
90%
RISE DISTANCE
RISE DISTANCE
SAMPLE RISE DISTANCE CALCULATION

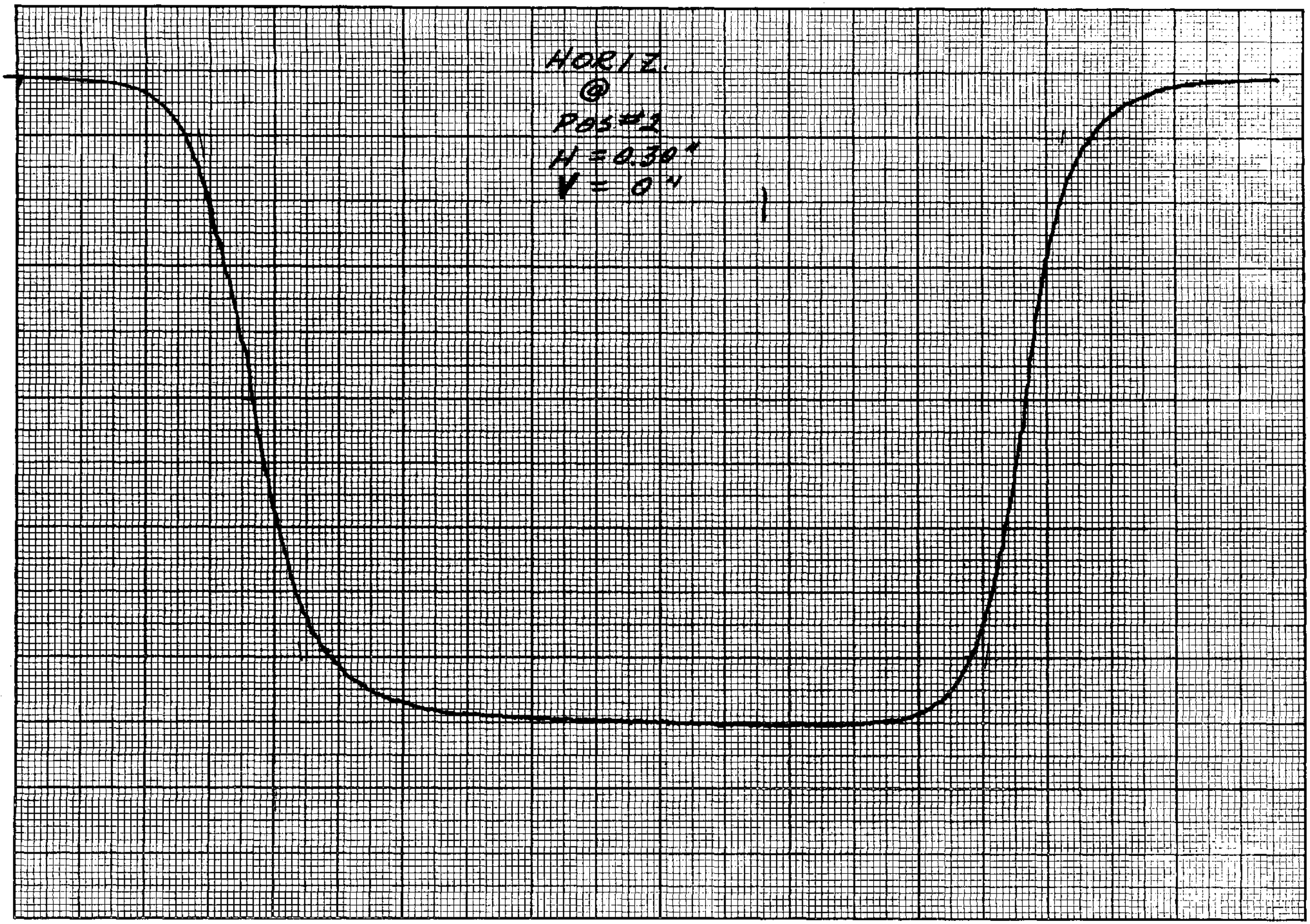
[redacted]E 20[redacted] TO T[redacted]CH [redacted]242[redacted]
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

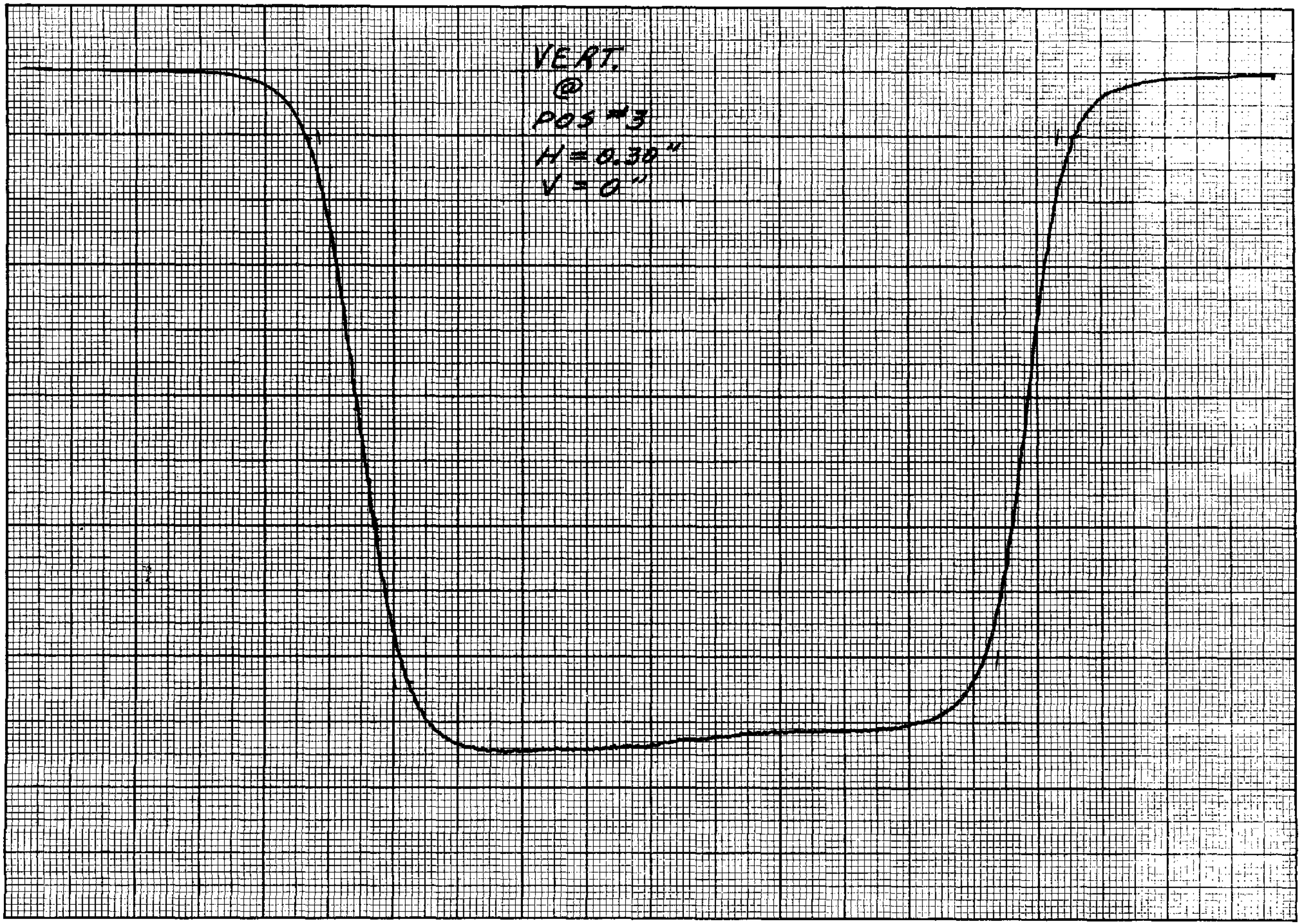


[redacted] 2[redacted] TO 1[redacted]CH [redacted]242
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.




VERT.
@
POS #2
H= 0.30"
V= 0"


HORIZ.
@
POS #2
H = 0.30"
V = 0"


VERT.
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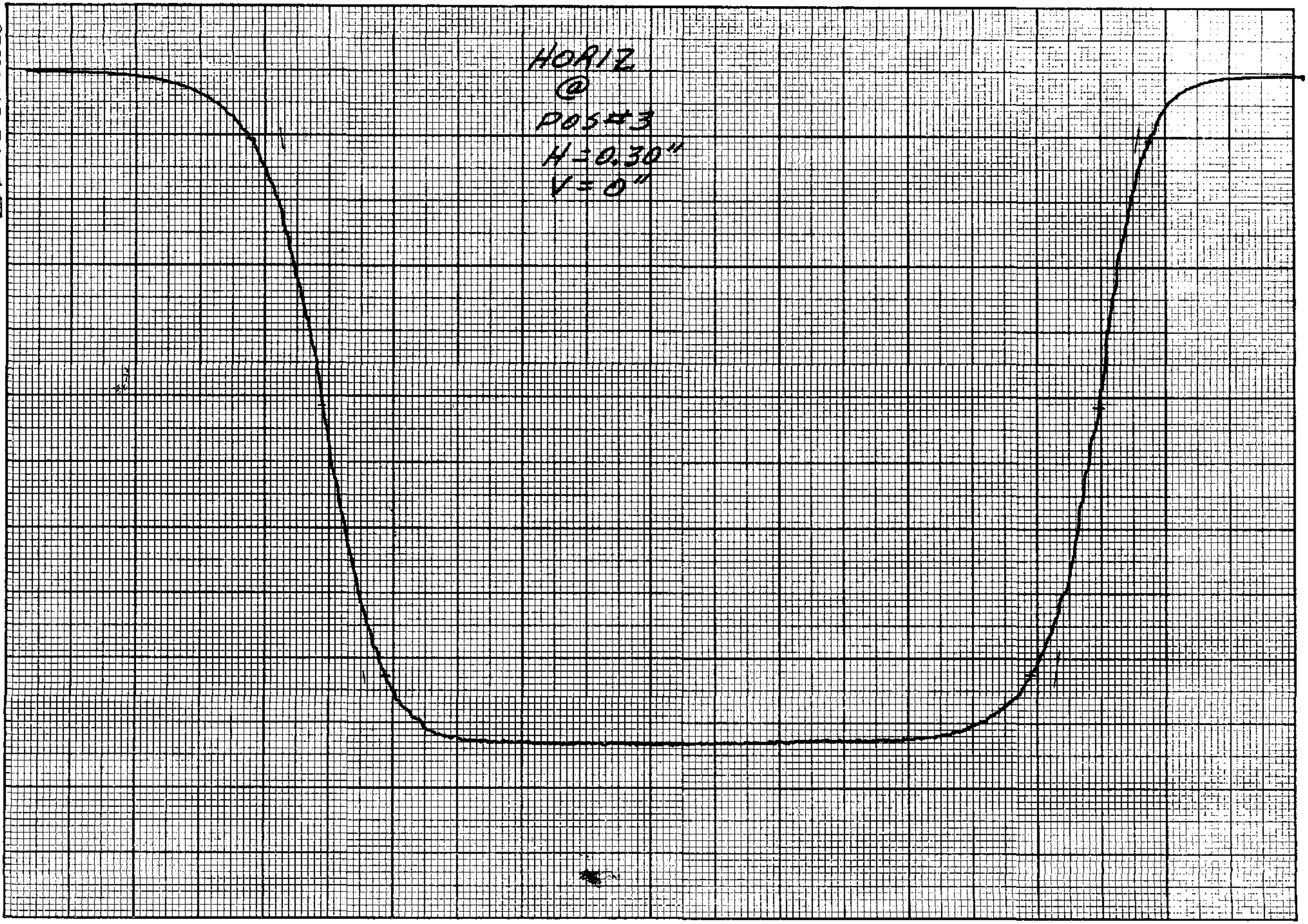
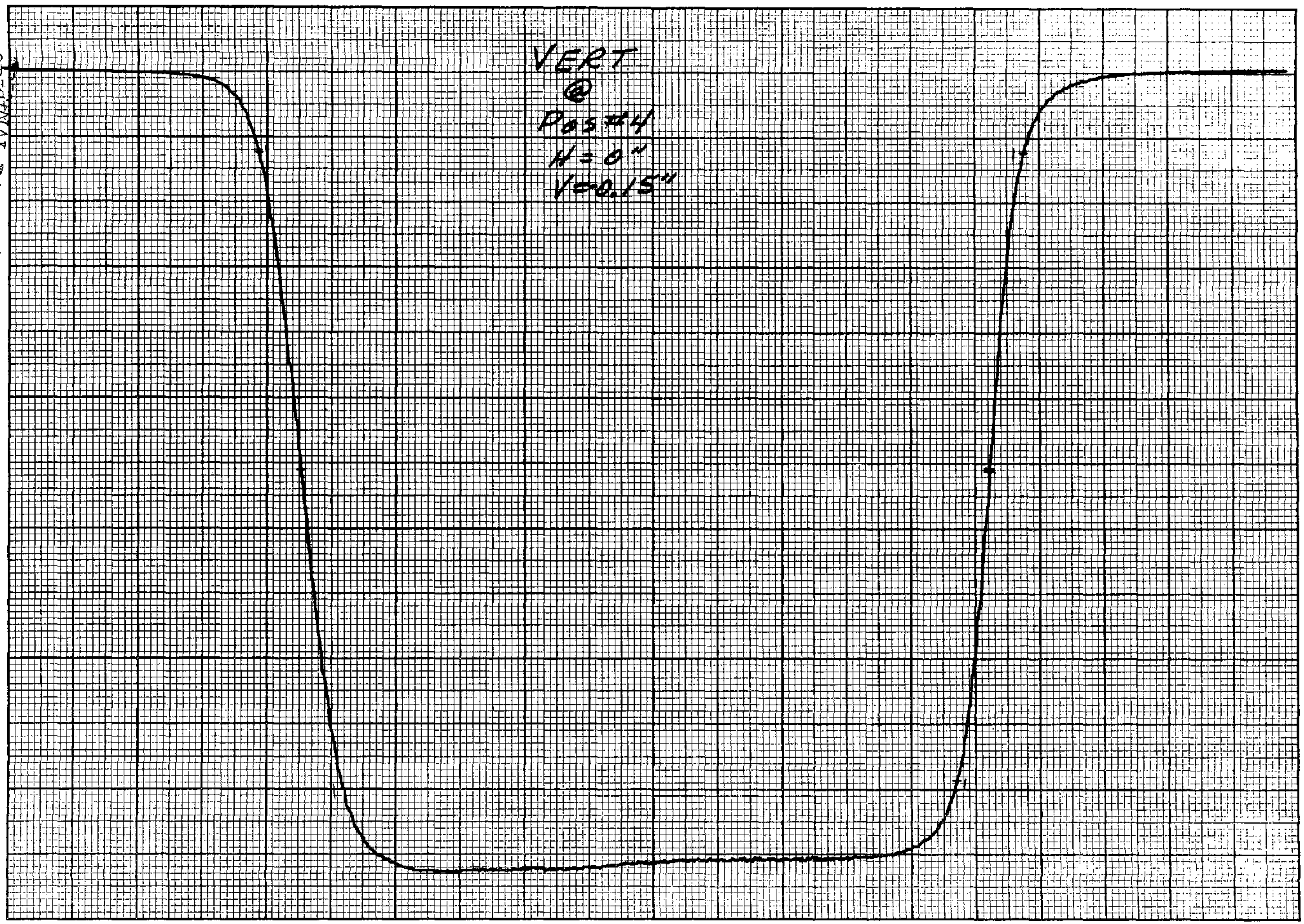
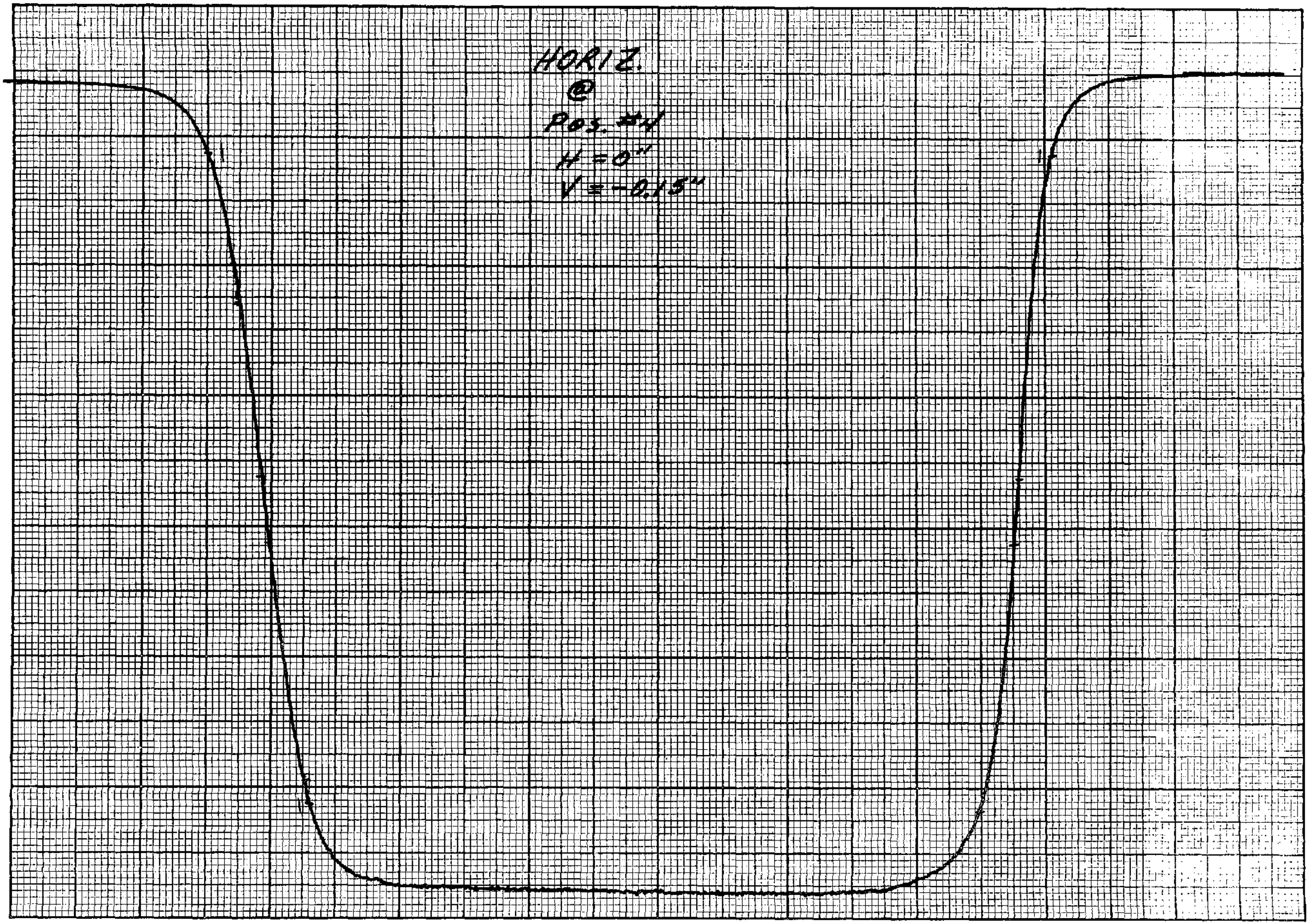
V = 0"


HORIZ
@
POS#3
H=0.30"
V=0"

[redacted] 2[redacted] TO [redacted]CH [redacted]242
7[redacted]NCHES[redacted]U.S.A.
KEUFFEL & ESSER CO.

ORIGINAL PAGE IS
OF POOR QUALITY




HORIZ.
@
Pos. #4
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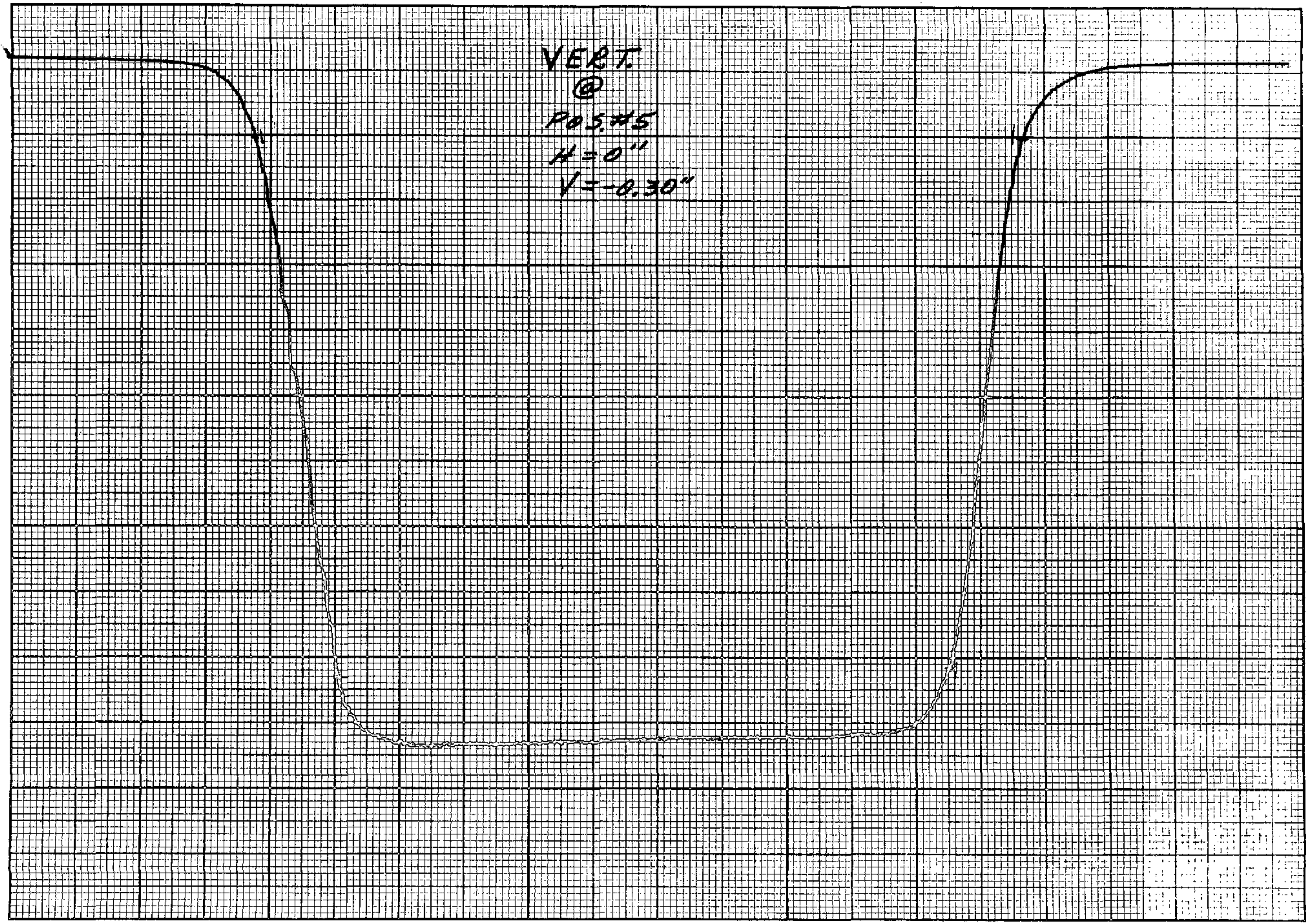
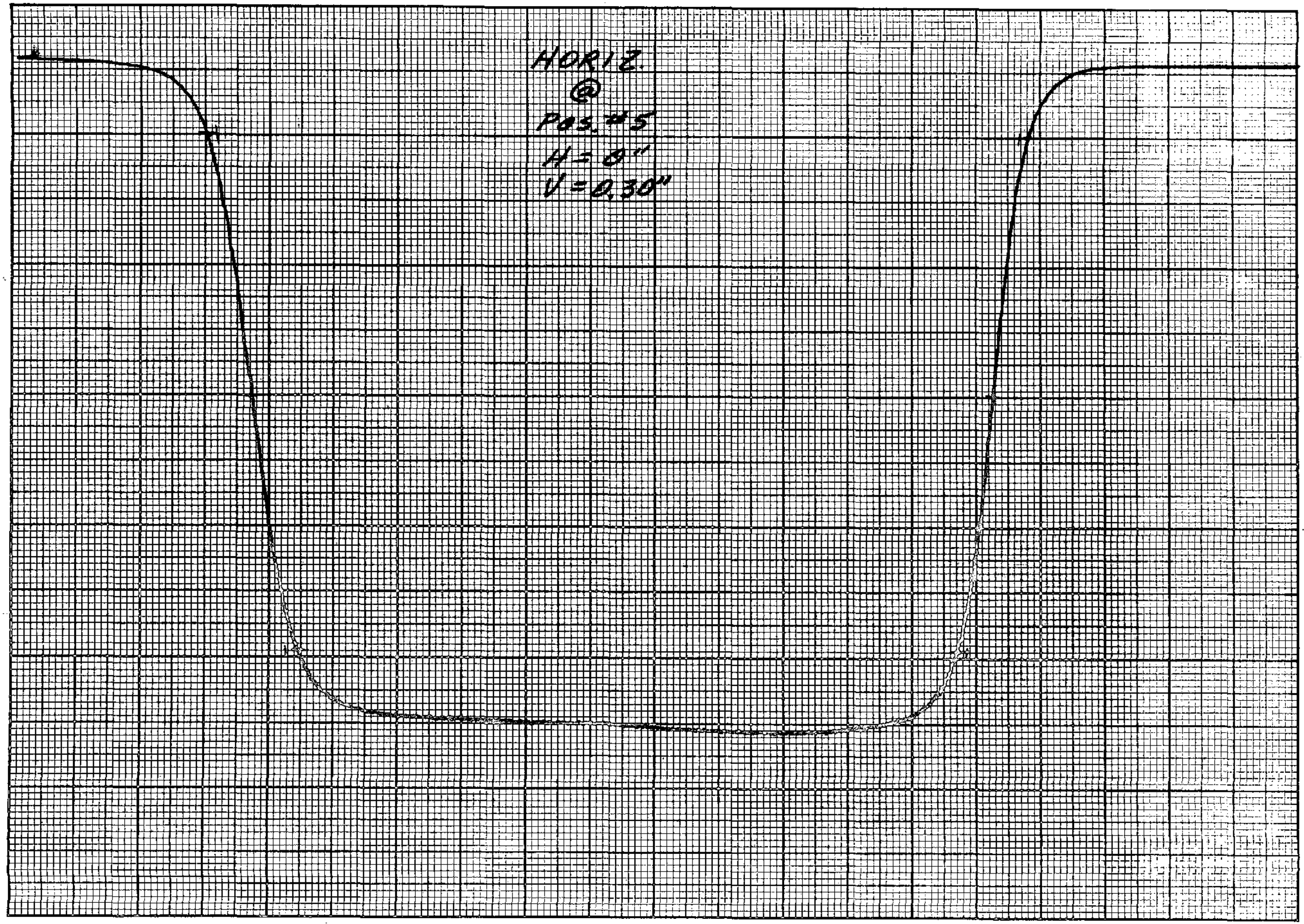
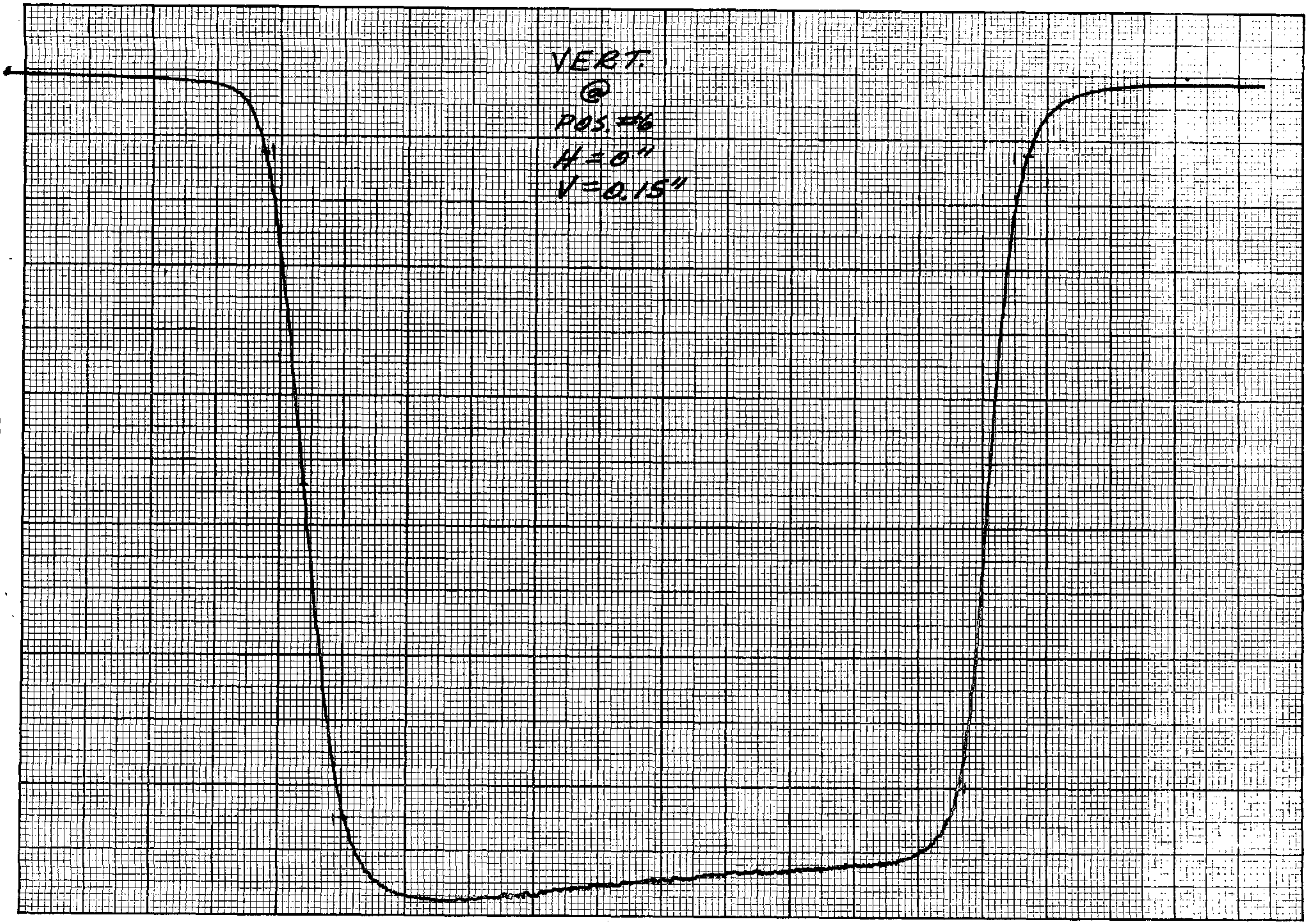
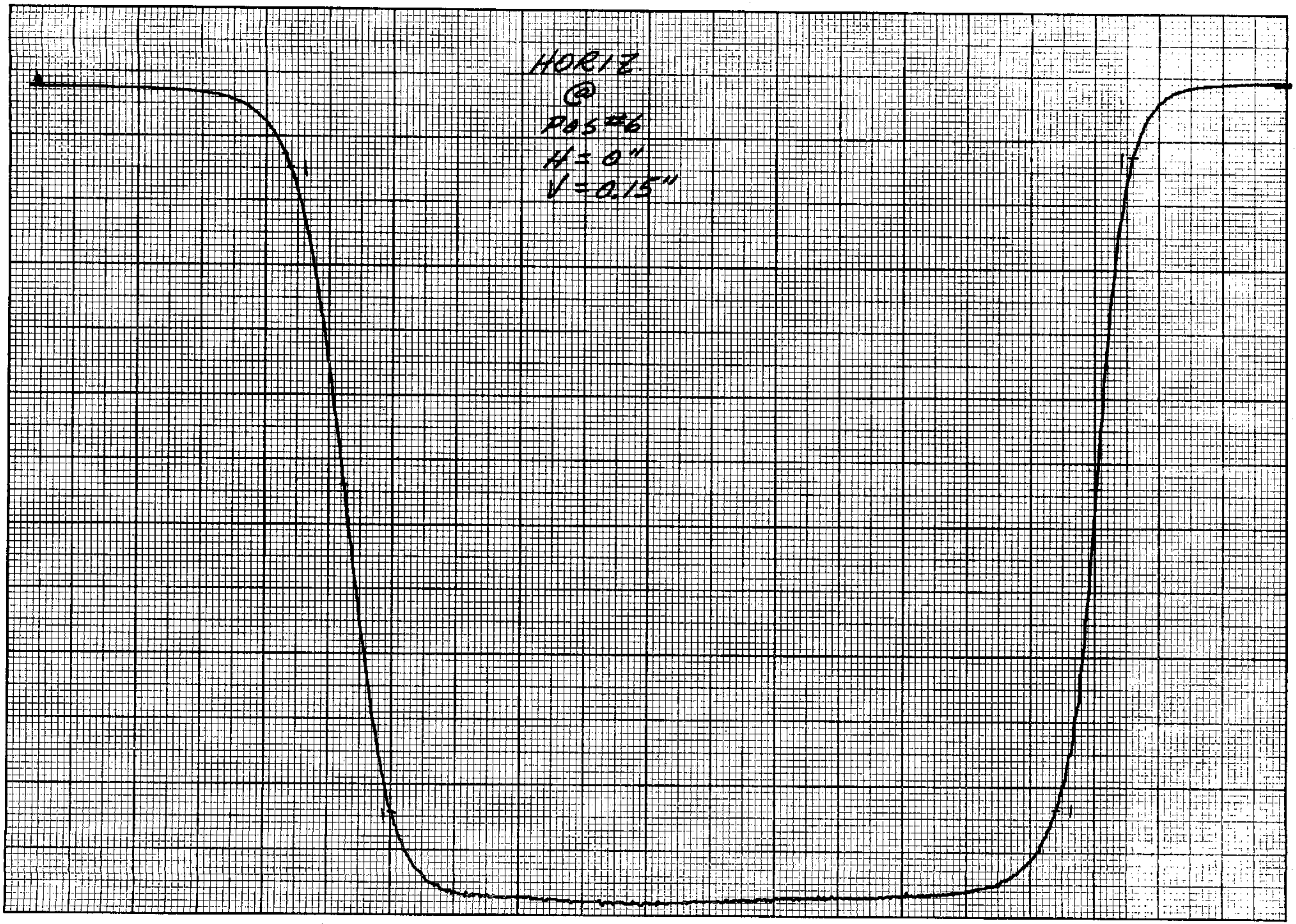
V = -0.15"

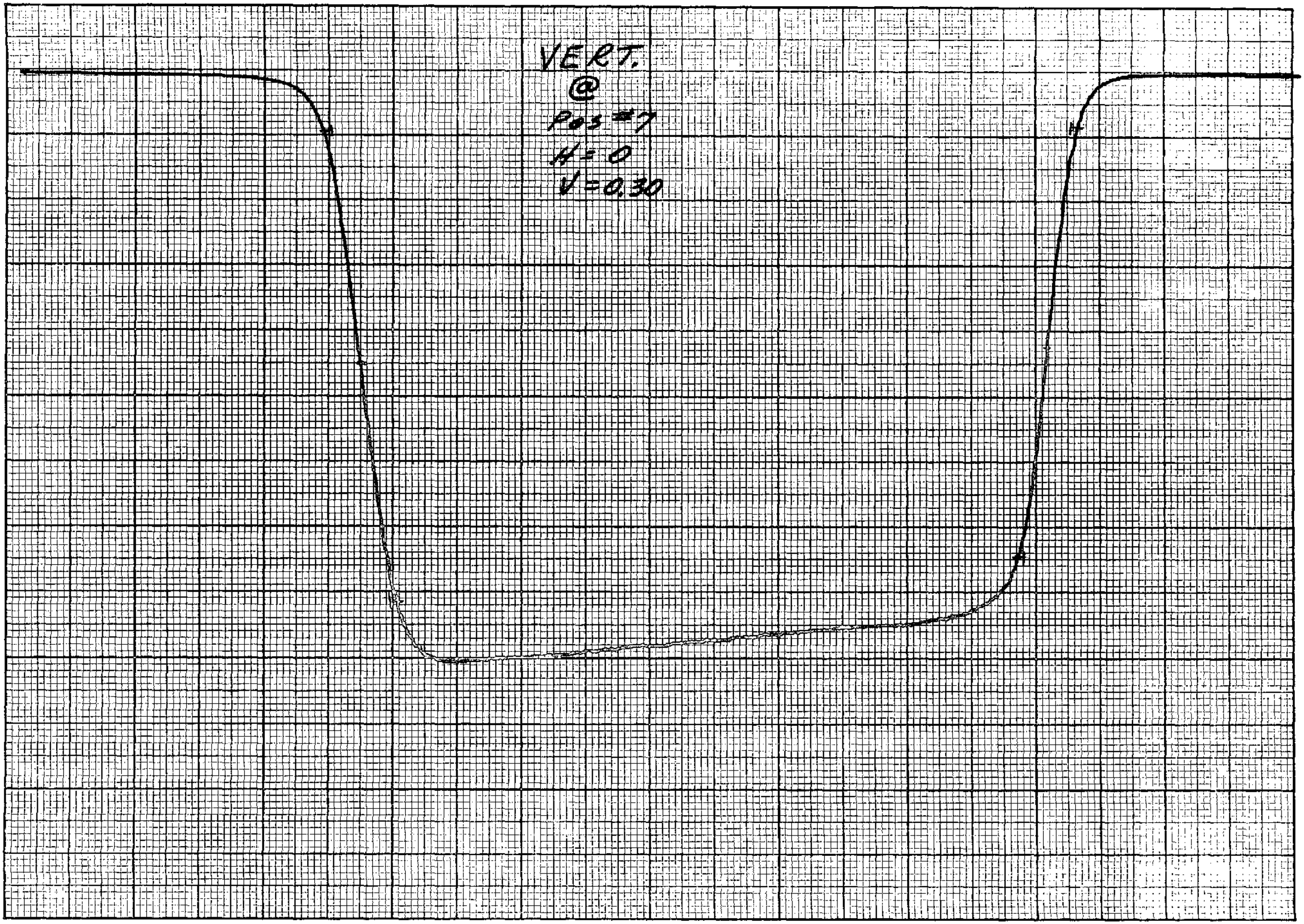

VERT.
@
POS.#5
H=0"
V=-0.30"

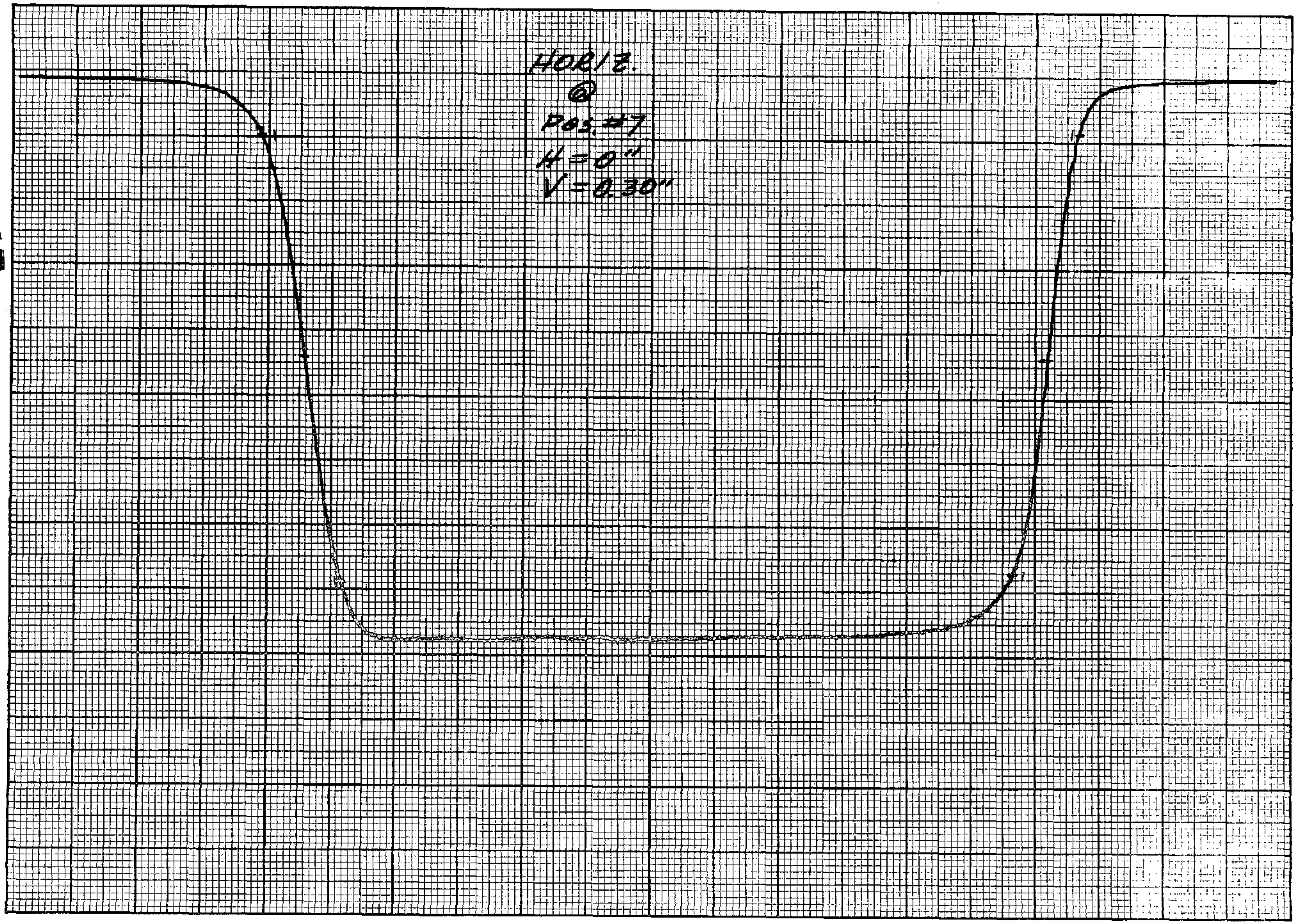

HORIZ.
@
POS. #5
H = 0"
V = 0.30"


VERT.
@
POS. #6
H=0"
V=0.15"

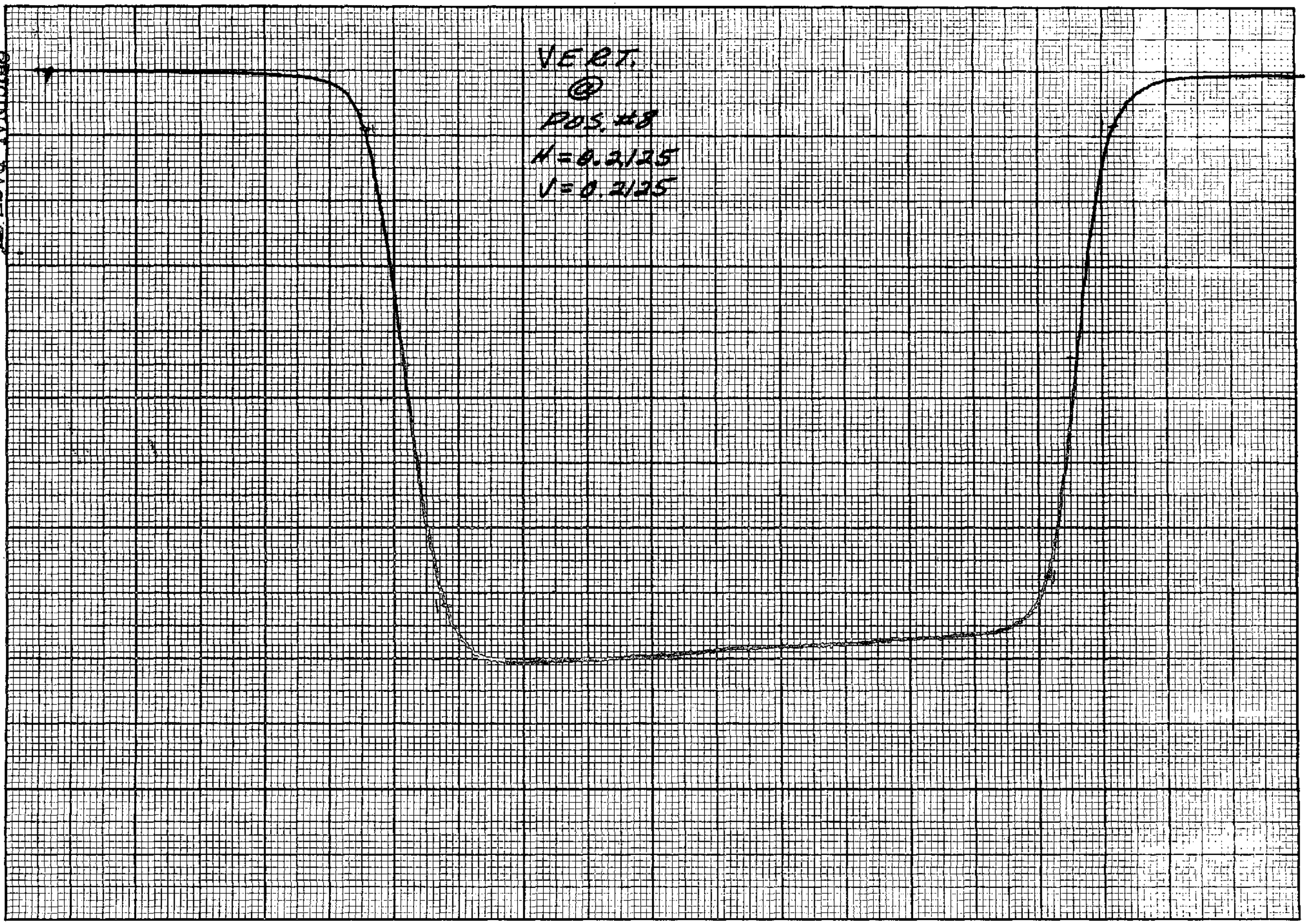
[redacted] 3[redacted]0 TO [redacted]NCH [redacted]242[redacted]
[redacted] INCHES [redacted]
KEUFFEL & ESSER CO.

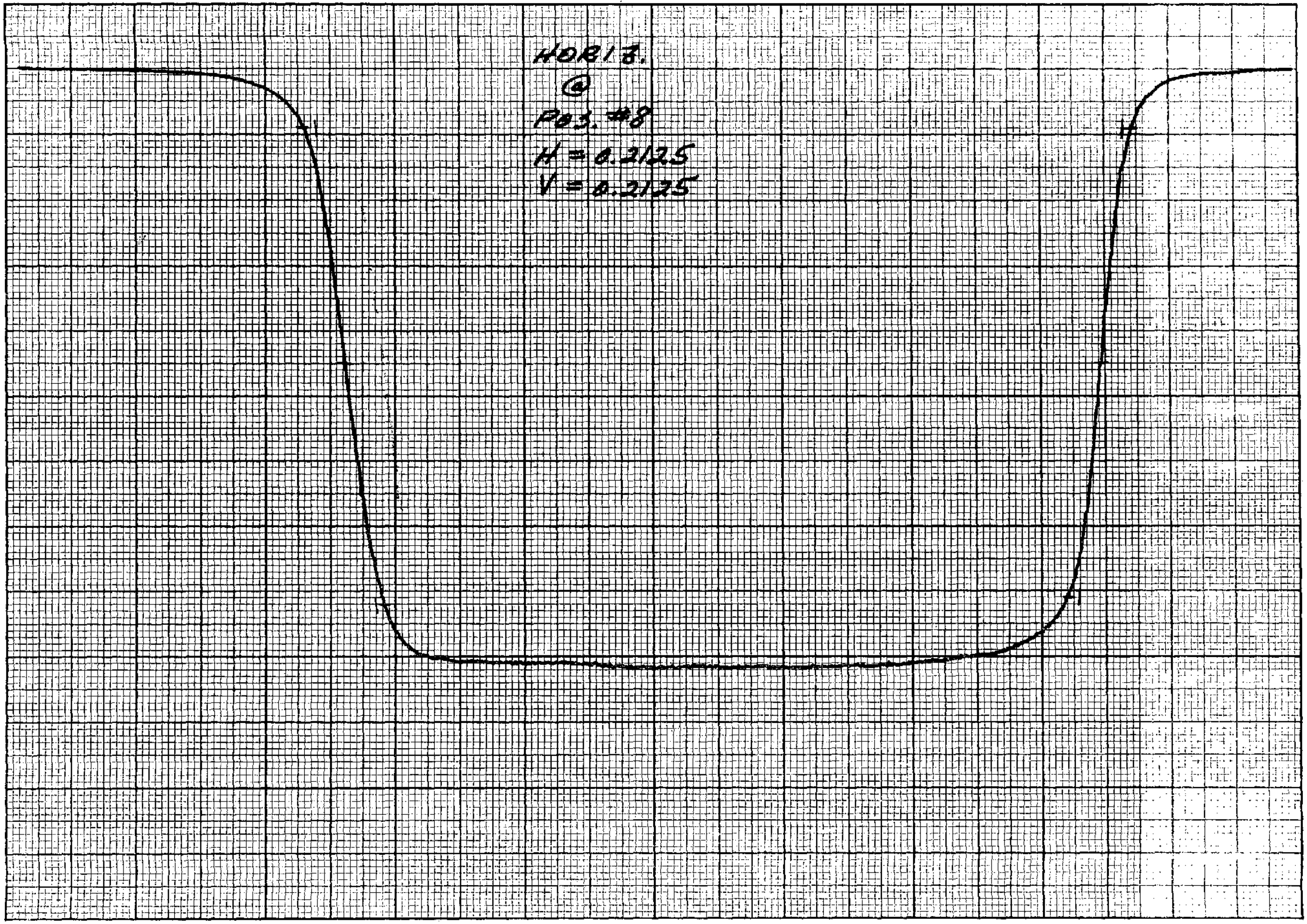


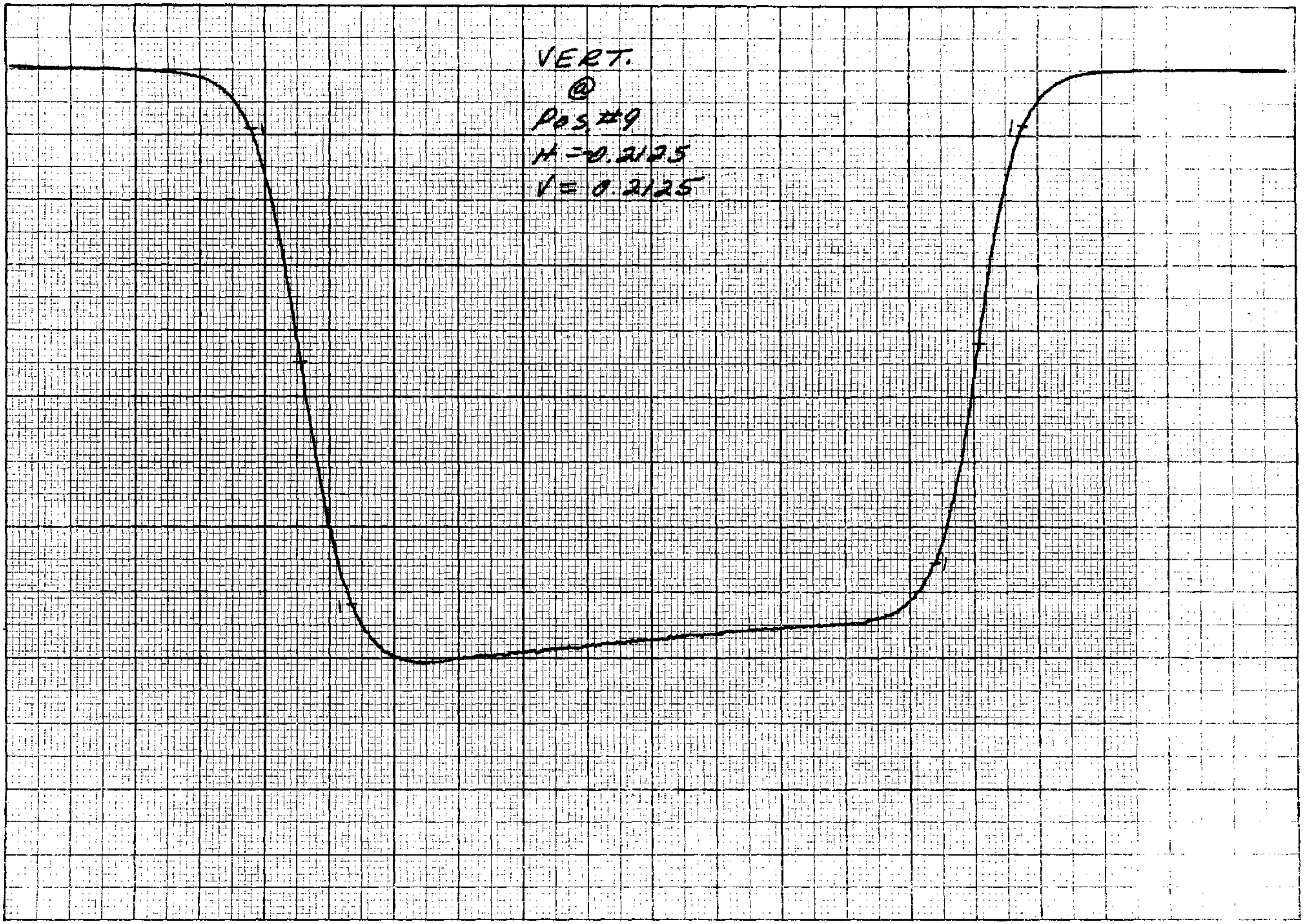

VERT.
@
Pos #7
H=0
V=0.30

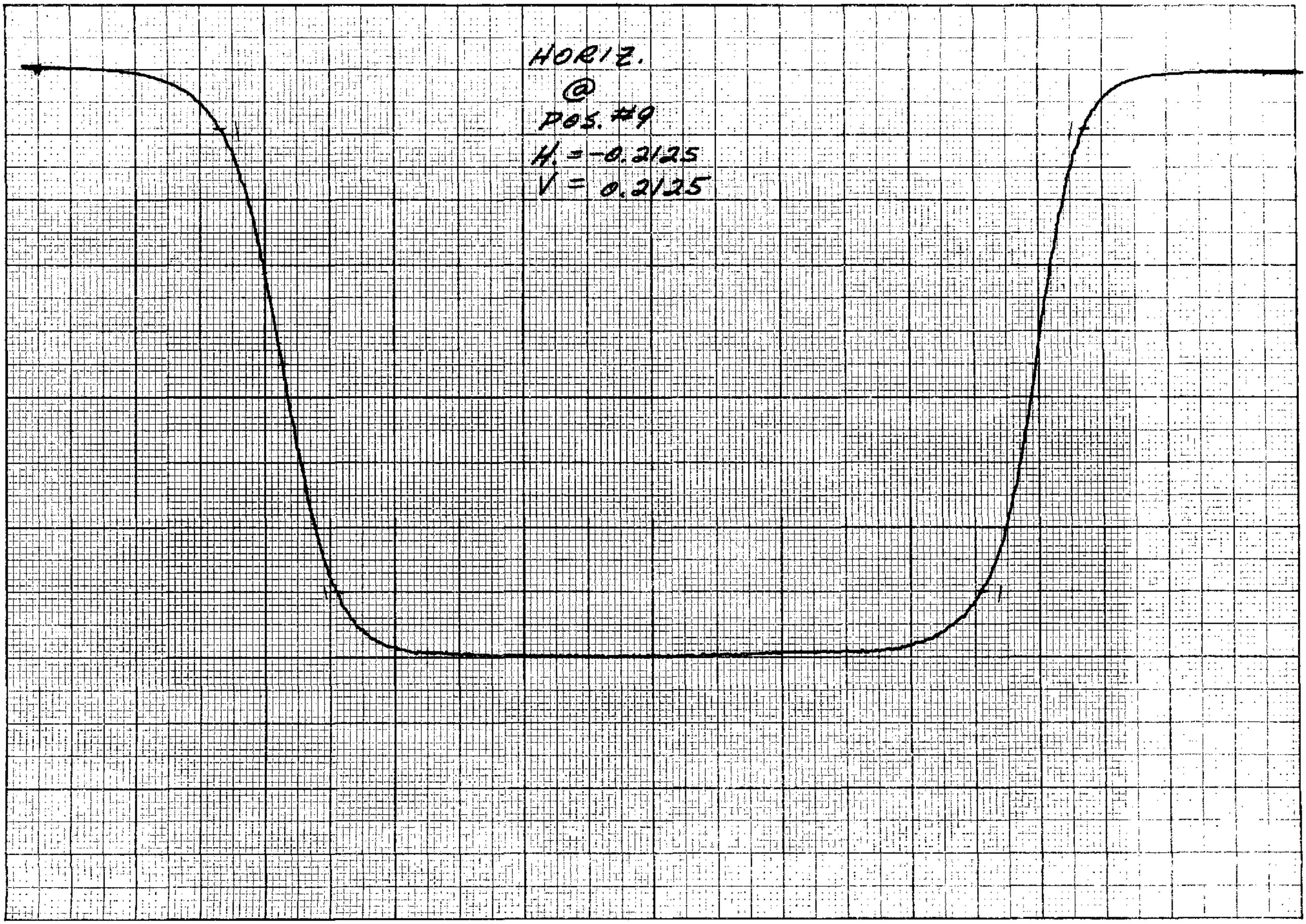

HORIZ.
@
Pos. #7
H = 0"
V = 0.30"

[redacted] K+E [redacted] TO [redacted] INCH [redacted] 1242 [redacted]
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.




HORIZ.
@
POS. #8
H = 0.2125
V = 0.2125


VERT.
@
Pos #9
H = 0.2125
V = 0.2125


HORIZ.
@
POS. #9
H. = -0.2125
V = 0.2125

5.8 Magnetic Field Effect

Attach tube mask with an aperture having 0.002" dia. pinhole to the vidissector face plate. Remove the collimator and image lens from test table. To determine the stability of the deflection system under the influence of an external magnetic field, place the Helmholtz coils parallel to the tube and coil so that with the coils energized, ~~a 1~~ 4 gauss is present in the vicinity of the coil in a transverse direction. Turn on static test unit in track mode. Obtain track by positioning the laser beam over one of the holes in the tube mask. With external field turned off, record horizontal and vertical deflection current in Table VII. Turn on external field and again record horizontal and vertical deflector current for this position. Repeat for each of the pin holes in tube mask as shown in Table VII. Repeat for other lateral field and longitudinal field.

5.9 Stability, Temperature

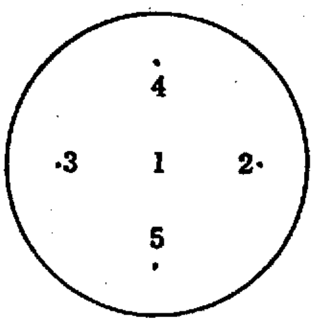
With the mask attached to the vidissector faceplate, place tube and coil assembly in temperature chamber. Mount on a stable platform with tube faceplate perpendicular to the temperature chamber window. Make connection from the static test unit to the vidissector tube, focus coil. Vertical deflection and horizontal deflection coil as shown in Figure 2. Mount the laser on a motion table and place perpendicular to the tube faceplate outside of the temperature chamber. Adjust table to position laser image on pin hole of the mask. Turn on static test unit and allow 30 minute warm up. (Block laser beam to tube while warming up). With the scan mode in "track" measure and record the required time, temperature, voltage and current listed in Table VIII. Measure and record the horizontal and vertical static deflection current at each of the 9 data points listed in Table VIII. Turn static test unit off. Stabilize thermal chamber at 130° F for one hour. Turn static test unit on and repeat after 30 minute warm up. Turn static test unit off. Repeat sequence at 70° F and 32° F.

Table VII -A

5.8 Magnetic Field Effect

Tube Mask Position No.		No. External Field	External Field Gauss ±4 G	Movement in Milli inch
1	Horiz	0 ✓	0 ✓	0
	Vert	0 ✓	0 ✓	0
2	Horiz	6.427 ✓	6.428 6.426	0.09
	Vert	-0.014 ✓	-0.013 -0.015	0.11
3	Horiz	-6.404	-6.405 -6.403	0.09
	Vert	-0.008	-0.009 -0.007	0.11
4	Horiz		0.082 0.084	0.09
	Vert			0.11
5	Horiz		-0.082 -0.084	0.09
	Vert		-5.640 -5.639	0.05

Tube Mask



Looking at front of tube

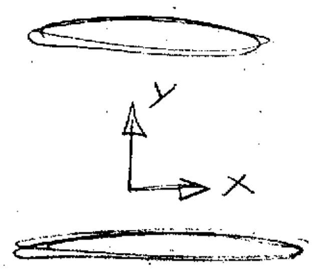
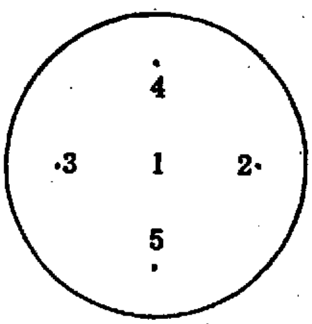


Table VII - B

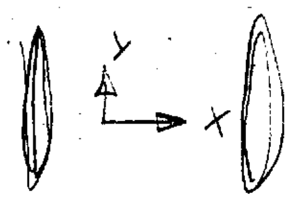
5.8 Magnetic Field Effect

Tube Mask Position No.		No. External Field	External Field Gauss ±4G	Movement in Milli inch
1	Horiz	0	0	0
	Vert	0	0	0
2	Horiz	6.427	6.428 6.426	0.09
	Vert	-0.013	-0.012 -0.014	0.11
3	Horiz		-6.405 -6.404	-0.05
	Vert		-0.009 -0.008	-0.05
4	Horiz		0.083 0.083	0
	Vert		5.645 5.645	0
5	Horiz		-0.082 -0.083	-0.05
	Vert		-5.641 -5.640	-0.05

Tube Mask



Looking at front of tube



C-2

COMPONENT SCHEMATICS

Voltage Divider

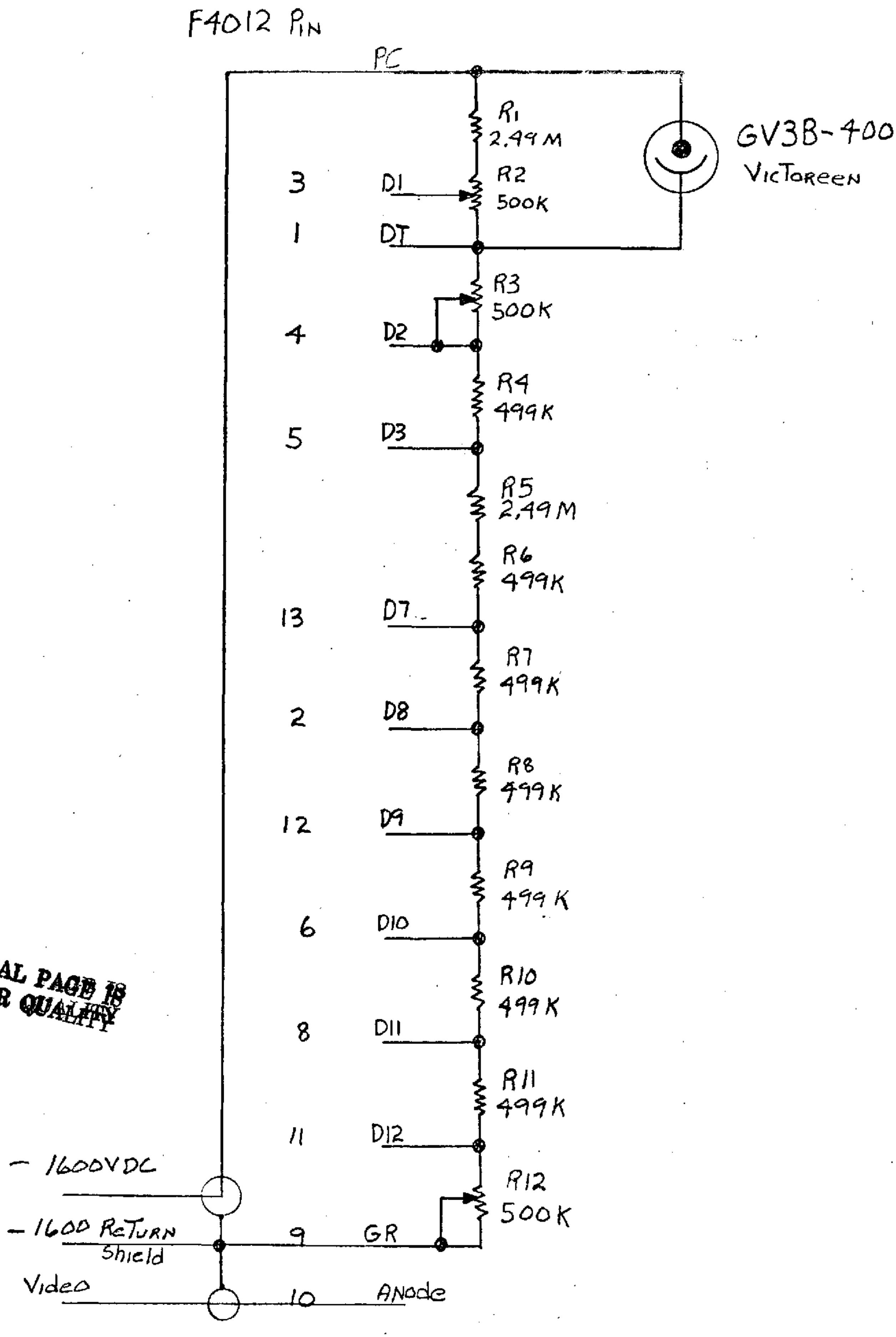
Deflection Assembly

Shield-Magnetic

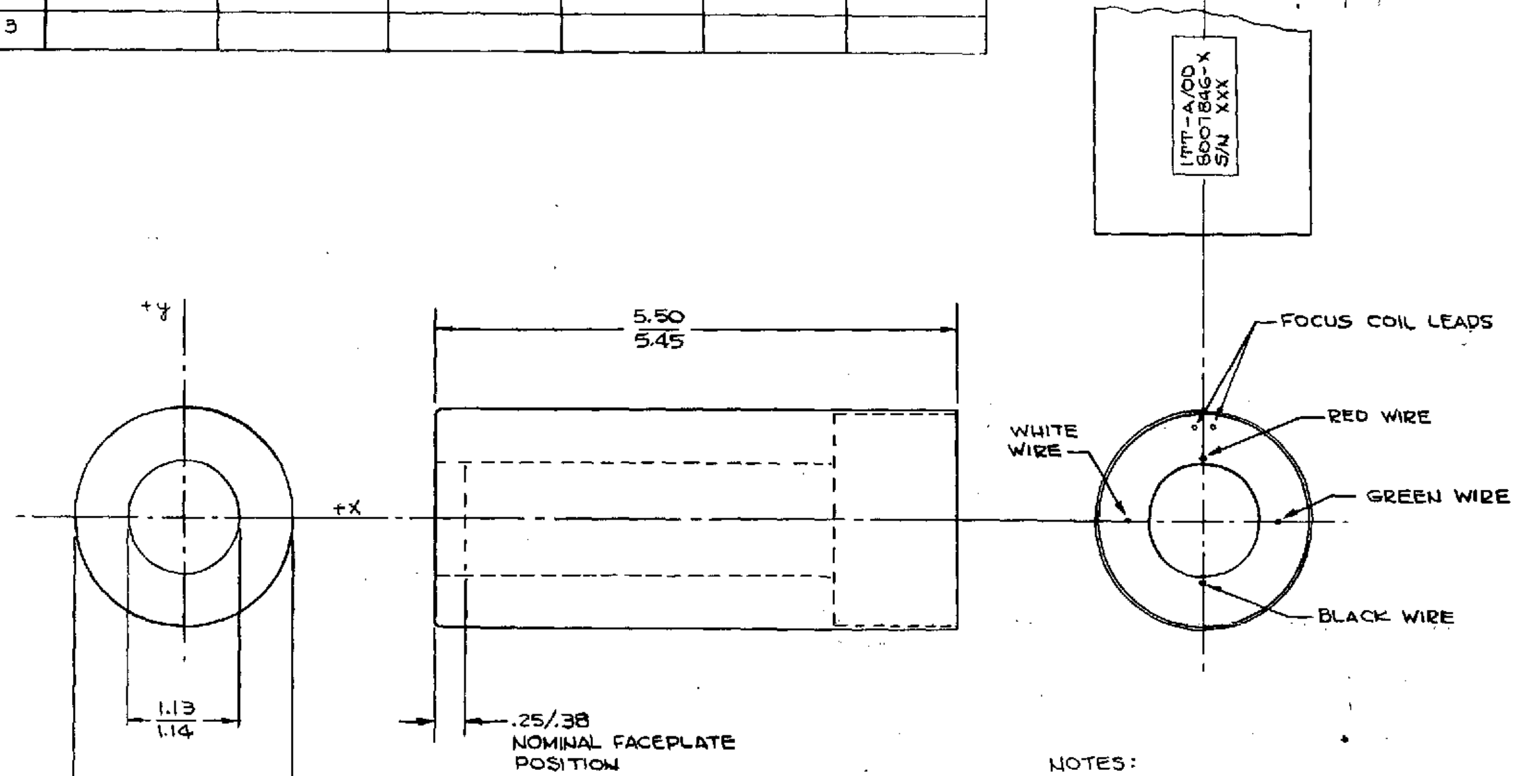
PROCESS SPEC -

Shell EPON - 828

DIVIDER F4012 Tube

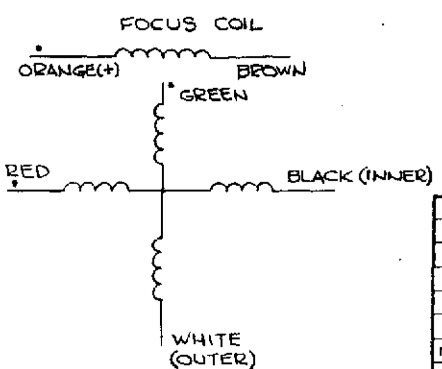


DASH NO.	DEFLECTION COIL (INNER/OUTER)			FOCUS COIL		
	Lp (mHy) (3)	R (Ω) (4)	I (mA/INCH) (5)	Ls (mHy) (3)	R (Ω) (4)	I (mA) (5)
1	42/47	140/147	60/70	325	135	97
2						
3						



NOTES:

1. FOCUS POLARITY : ORANGE POSITIVE.
2. DEFLECTION POLARITY : RED POSITIVE, EFFECTIVE APERTURE DEFLECTS +X. GREEN POSITIVE, EFFECTIVE APERTURE DEFLECTS +y.
3. INDUCTANCE MEASURED AT 1000 Hz
4. RESISTANCE AT 23°C.
5. FOCUS AND DELECTION CURRENTS ARE FOR A F4012RP AT 400 VOLTS, FIRST LOOP.
6. LEAD LENGTH 12 IN. MIN.
7. WEIGHT: 0.94 Kg



G7	G6	G5	G4	G3	G2	G1	ITEM NO.	SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
QUANTITY PER GROUP										

LIST OF MATERIALS OR PARTS LIST

NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES

BASIC DIMENSION	DECIMALS 2 PLACE	DECIMALS 3 PLACE	ANGLES
UNDER 6	±.02	±.010	
6-24 INCL.	±.03	±.020	
OVER 24	±.06	±.030	

DO NOT SCALE PRINT

COML. TOL. TO STOCK SIZES

SHOP PRACTICE 39.101 APPLIES

CONTRACT NO.

APPROVALS

DRAWN

CHECKED

ENGR

ITTAOD

OTHER

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

DEFLECTION ASSY, 1 INCH
VIDISSECTOR® IMAGE DISSECTOR

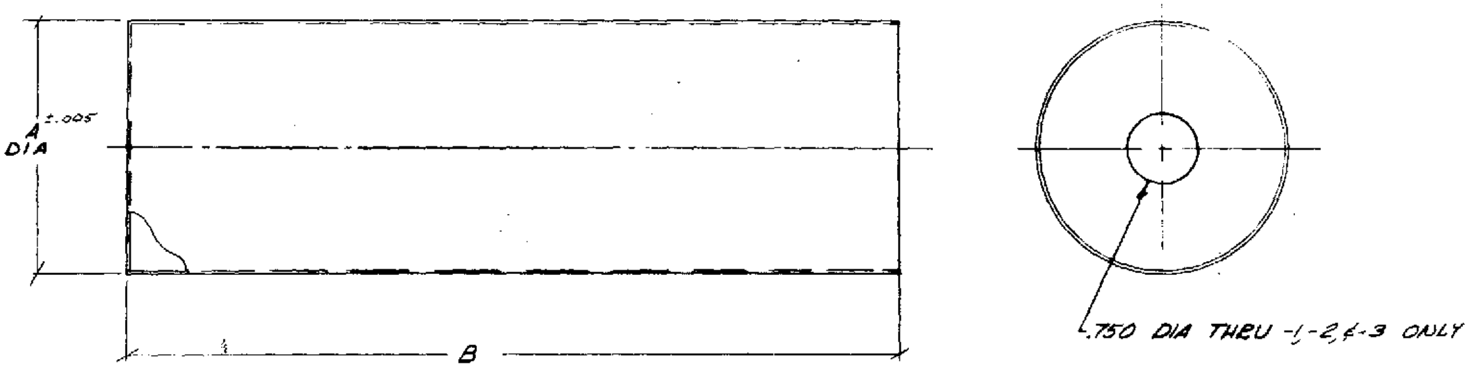
DWG SIZE	CODE IDENT NO.	
C	31550	8007846

SCALE

SHEET

ORIGINAL PAGE IS OF POOR QUALITY

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
	REL PER [illegible] 4595	[illegible]	



-NO	A	B
-1	2.407	8.108
-2	2.549	8.179
-3	2.691	8.250
-4	2.733	.38 △2

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SIZE C 5524595

SHEET 1

1. △ RECOMMENDED SOURCE: PERFECTION MICA CO. 1322 N. ELSTON AVE CHICAGO 22 ILL.
2. △ -4 PART TO BE SNUG FIT OVER OPEN END OF -3 PART
3. ALL WELDING TO BE DONE UTILIZING ELECTRON BEAM WELDING TECHNIQUE.

DASH NO.	NEXT ASSY	USED ON	AUTHORIZED FOR
			STORAGE
			EXP FILE
			ENGR REL
-1	—	6822-21002	PROD REL
	APPLICATION		

-1 AS SHOWN

SEE SEPARATE PL WHEN FIND NUMBERS ARE USED

APPLY PART NO. PER GPS30-101-

MATERIAL: CONETIC AA .031 THICK △1

FINISH

☐ INDICATES CROSS REFERENCE BETWEEN CALLOUTS AND NOTES

DIMENSIONS ARE IN INCHES

TOLERANCES UNLESS OTHERWISE SPECIFIED

LINEAR	ANGULAR
.XX ± .03	± 0° 30′
.XXX ± .010	

GPS60-006 SUPPLEMENTS THIS DRAWING, PROVIDES ADDITIONAL CONTROLS, AND INTERPRETS DIMENSIONS AND TOLERANCES

CONTRACT NO.

DATE	FEB 2 1974	
DRAWN	J McKenzie	2/1/74
CHECK	[illegible]	2/1/74
M. E.	[illegible]	2/1/74
E. E.	[illegible]	2/1/74
PROJECT	MANUFACTURING	
APPROVED		

ITT Gilfillan Van Nuys, California

SHIELD-MAGNETIC

SIZE C | CODE IDENT NO. 24930 | DRAWING NO. 5524595

SCALE 1/1 | WT LBS | SHEET 1 OF 1

FORM NO. 509 12/72 DIETZGEN-POST 3111B .003

APPLICATION	
NEXT ASSY	USED ON

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

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SHEET SIZE																									
REV LETTER																									
SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

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TOLERANCES

DECIMALS		ANGLE
2 PLACE	3 PLACE	
±.02	±.010	±½°

CONTRACT NO.

APPROVALS	
DRAWN	R. Hester 2/7/74
CHECKED	
ENGR	R. Hester 2/7/74
ITTAOD	R. Swindler 2-8-74
OTHER	[illegible] 2/8/74

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

PROCESS SPECIFICATION FOR RIGID EPOXY INSULATING ADHESIVE/ENCAPSULANT

SIZE	CODE IDENT NO.	
A	31550	8007841
SCALE		SHEET 1 of 3

FORM NO. FW ITTAOD D 101

LINCOLN-GRAPHIC CORP. 10 5153 1M 4-70

1.0 SCOPE

This specification defines the formulation and procedure for preparing and curing a rigid general purpose epoxy resin adhesive or encapsulant. This material may be used as a cement in assembly or as an encapsulant for electronic components and/or assemblies intended for space flight use.

2.0 MATERIALS AND SPECIFICATIONS

2.1 Base Epoxy Resin

ITTIL Spec. #4720538, "Insulating Compound, Electrical, Embedding, General Purpose Materials Specification" (Shell Chemical Co. - Epon 828).

2.2 Curing Agent

Epon curing agent D.

3.0 MIXING FORMULATION

3.1 Epon 828 - 100 parts by weight. Curing Agent D 12 ± 0.5 parts by weight.

4.0 MIXING PROCEDURE

4.1 Measure the proper proportions by weight of Epon 828 and curing agent D into the mixing container. Use aluminum cups for small quantities or beakers for larger amounts.

NOTE: Measure a sufficient amount to ensure the quantity is adequate for the application. In no case shall a mixture of less than 10 grams be used.

4.2 Mix thoroughly the Epon 828 and Curing Agent D. The mixture may be heated to 45°C for 2 minutes to reduce the viscosity and enhance the mixing.

4.3 Cover the container with a plastic bag, when a beaker is used, and place the container in a vacuum chamber. Lower the pressure to approximately 200µm. The resin and curing agent mixture will rise and froth; leave the resin in the vacuum chamber for 10 minutes after the major frothing ceases.

4.4 Remove the mixture from the vacuum chamber. The mixture is now ready for use per detailed assembly drawing instructions.

ITT AEROSPACE/OPTICAL DIVISION
FORT WAYNE, INDIANA, U.S.A.
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

5.0 CURING PROCEDURE

5.1 Cure the encapsulated assembly per the following schedule:

5.1.1 Three hours at 65°C to jell mixture.

5.1.2 Post cure at 125°C for 1 hour.

5.2 After curing cycle is completed, turn off the oven and allow the assembly to return to room temperature.